MODERN BUILDING PRACTICE

AN UP-TO-DATE AND PRACTICAL WORK DEALING WITH THE DESIGN, PLANNING, CONSTRUCTION, AND EQUIPMENT OF MODERN BUILDINGS

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VOLUME I

DESIGN AND PLANNING

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The Index to the subject-matter contained in this Volume will be found at the end of Volume IV.

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CONTENTS OF VOL. I

MODERN BUILDING PRACTICE

VOL. I.

DESIGN AND PLANNING

INTRODUCTION

DURING the past few years immense progress has been made in the technique of building. Many new materials and methods have been introduced. In the larger buildings, structural steelwork has become the rule rather than the exception. New flooring materials, roofing materials, wall coverings and interior finishes in endless variety have been introduced within recent years. Many of these new materials widen the scope of the designer and call for special knowledge on the part of the craftsman. Questions of heating, ventilation and air-conditioning, lighting and acoustics of buildings are becoming more and more important, both to the architect and to the building contractor responsible for the installation.

The present work has been designed to bring together, in a form convenient for reference by the architect and builder, all those details of design, construction and equipment which are necessary for the man who wishes to have a reliable source of information at his finger-tips.

Side by side with this development in technique there has been a corresponding development in architectural design.

This first volume—which is devoted to the subject of Design and Planning—brings together in a convenient form some noteworthy examples of design and planning by the best British architects of to-day.

Some Interesting Figures

Nearly 75 per cent. of all the building work done in this country is domestic. The remaining 25 per cent. may be allocated broadly as follows :—

Municipal and public buildings (including churches)	$7\frac{1}{2}$ per cent.
Industrial and commercial buildings (factories, offices, banks, etc.)	10 per cent.
Cinemas, theatres and concert halls, etc.	$7\frac{1}{2}$ per cent.

The capital value of buildings erected in this country during one year is in the neighbourhood of £200,000,000. Using the above percentages as a basis, we see that every year domestic building involves a turnover of about 150 million pounds; municipal and public buildings, about 15 million; industrial and commercial buildings, 20 million; and buildings erected for our entertainment, about 15 million.

Beneficial to Both

It is quite safe to say that all buildings coming under the last three groups are planned and designed by architects, and, in the great majority of cases, erected under their supervision.

There can be no question that this is desirable and beneficial, not only to the members of the architectural profession, but also to the great craft of building, without which, architecture would be non-existent. The finest conceptions of the architect depend for their execution upon the craftsmanship of the builder, but, conversely, the builder can only reach the highest pinnacle of craftsmanship when the building which he is erecting has been planned and designed by an architect.

The object of this first volume is to set out concisely the principles underlying the design and planning of all types of buildings: Small Houses—Medium-sized Houses—Blocks of Flats—Cinemas and Theatres—Town Halls—Churches—Public Libraries—Hotels—Works and Factories—Shops and Departmental Stores—Swimming Baths and Open-air Pools—Concert Halls, etc., and to show, by actual examples of the best modern work, how these principles have been applied in practice.

Architect-designed Houses

Considerable space has been devoted to the question of domestic architecture; and in this connection may be mentioned a special section dealing with the question of laying out a housing estate to the best advantage.

An increasing number of medium-sized houses, ranging from £1,000 to £3,000 in cost, is being to-day designed by architects.

THE OFFICES OF THE LONDON PASSENGER TRANSPORT BOARD

Widely known to the public through the controversy regarding the Epstein reliefs, but noteworthy also as an example of functional planning combined with dignity of design. Note the suntrap motif. (*Adams, Howden & Pearson, FF.R.I.B.A.*)

A PRIVATE HOUSE NEAR WIMBLEDON

The design of houses is engaging the attention of some of our leading architects to an increasing degree. This is all to the good, and in the present volume considerable space has been devoted to this topic, as well as to the related subjects of housing estate planning and the planning and design of flats and communal dwellings. (*Sir Edwin Lutyens.*)

For smaller property, economic considerations sometimes prevent the builder from engaging the services of an architect, but we believe it will be generally agreed that the best results can be obtained only when good design and planning are wedded to sound craftsmanship.

Sound Principles Produce Good Practice

In this volume the broad principles which govern design and planning are outlined to enable the reader better to appreciate the points in an architect's design.

It was felt that the best method of enabling our readers to acquire an appreciation of the subject of design and planning would be to show some of the best work which has been produced by architects in this country within recent years.

An Acknowledgment

We take this opportunity of expressing our appreciation of the generous co-operation which has been afforded to us in this connection by some of the leading architects.

It is this co-operation alone which has made it possible for us to illustrate such a wide range of first-class work.

The Architect and the Builder

Both the architect and the builder will, we believe, find these examples of fascinating interest. The greater the knowledge of the architect, the more vivid will be his interest in comparing the work of some of the leading men in his profession. The reader whose present knowledge lies on the side of craftsmanship rather than design, can, by comparing the many examples given in this volume and reading the articles which accompany them, increase very greatly his appreciation of good architecture. To anyone in the building industry, an acquaintance with the hundreds of selected examples, illustrating the best work by modern British architects, will prove a valuable asset.

A Strong Combination

These examples show how skilful design and planning by the architect, when combined with the highly skilled craftsmanship of the builder, unite to produce finely proportioned buildings, pleasing to the eye, and perfectly adapted to the purposes for which they are intended.

The Legal Side

In this volume also, a certain space has been devoted to the legal side of the subject. Points of law which may affect the architect and the builder in their respective spheres have been clearly set

out and explained by our legal contributor, who has specialised in this subject.

Where Time Is Money

Space has also been found for a special section devoted to the question of the time schedule as it applies to building operations. A carefully planned schedule to govern the sequence of operations may often be the means of saving hundreds—if not thousands—of pounds in the cost of construction. Here again, the subject has been treated by an acknowledged expert, who has made a close study of this subject, not only in this country, but also in the U.S.A.

It is not likely that we shall see in this country, for many years to come, buildings comparable with the skyscrapers of New York, nor is it reasonable to expect that American styles of architecture are likely to be largely adopted in this country. Nevertheless, both the builder and the architect can learn much of value by studying some of the methods employed by our American cousins.

Speed of erection is not necessarily a desirable thing in itself, but when this celerity is combined with sound British craftsmanship, a most valuable combination is achieved.

Interplay Between Design and Craftsmanship Brings Progress

Neither architectural design nor building construction can be studied or practised to the full advantage independently of each other. Improvements in materials and constructional methods give greater scope to the architect. The architect who is not a slave to tradition is continually introducing new problems to the structural engineer and builder.

We take this opportunity of expressing our indebtedness to the many firms and individuals who have assisted in the production of this work. In particular we would mention: Messrs. Holland & Hannen and Cubitts Ltd., Messrs. Trollope & Colls Ltd., and Messrs. Hickman (1928) Ltd., who afforded special facilities to our photographers; the journals *Building*, *Architecture Illustrated*, and *Architects' Journal*, who have given permission to reproduce certain photographs; and The Yorkshire Copper Works Ltd., Messrs. Crittalls Ltd., Messrs. Henry Hope & Sons Ltd., The Cement and Concrete Association, and The Asphalt Roads Association, for supplying valuable data.

It is hoped that this volume, and its companion volumes dealing with Building Construction, Materials, Operations, and Equipment, will provide a valuable source of reference on all practical aspects of Architecture and Building.

GENERAL PRINCIPLES OF DESIGN AND PLANNING

THE primary factors controlling design and planning are numerous, but most important of all are :—

(1) The purposes of the building.
(2) The site.
(3) Economic considerations.
(4) Methods of construction.
(5) Precedent.

The sketches and diagrams which follow illustrate clearly some of the basic principles involved in the design and planning of various types of buildings.

Whereas in the case of buildings such as cinemas and theatres the predominating unit is obvious, in other buildings, such as hospitals, schools, etc., some difficulty may be experienced in establishing the relative importance of the various units in the plan, and examples of both these types of buildings are shown.

Other diagrams show how the question of site affects the planning of the building and how different buildings are planned to obtain a symmetrical or asymmetrical design.

The diagrams numbered 11 to 15 show good typical examples of wall texture, bases to walls, cornices and doorway and window openings, and their treatment. Full details of the particular problems met with in the design of various types of buildings will be found in later pages of this volume.

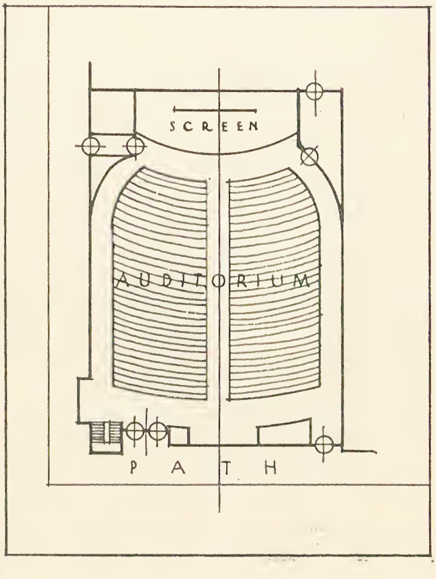

Fig. 1.—A SINGLE-UNIT TYPE OF PLAN

In the case of buildings such as cinemas, theatres, skating rinks, etc., the predominating unit is obvious. Compare this with Fig. 2, showing a building in which it is difficult to determine which is the predominating unit in the plan.

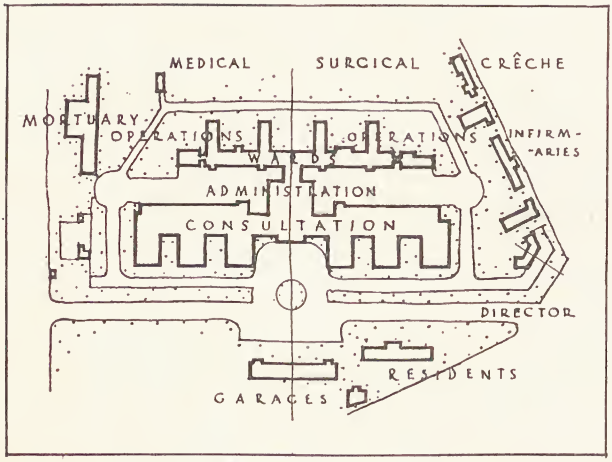

Fig. 2.—An example in which difficulty may be experienced in establishing the relative importance of various units in the plan

This is a hospital, in which a decision has to be made as to the relative importance between wards, operating theatres, out-patients' and casualty departments and so on. These points will be dealt with in a later article.

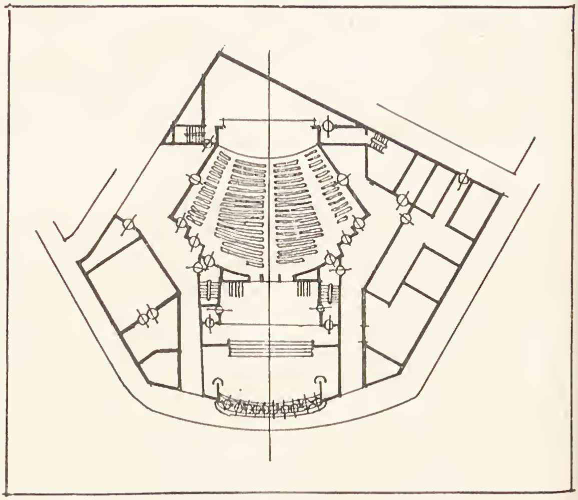

Fig. 3.—An irregular-shaped site

In many cases it will be found that the site embodies features that influence the plan. Restrictions and difficulties on the site may be occasioned by (*a*) nature of sub-strata which affects foundation work; (*b*) levels; (*c*) orientation, frontage and access.

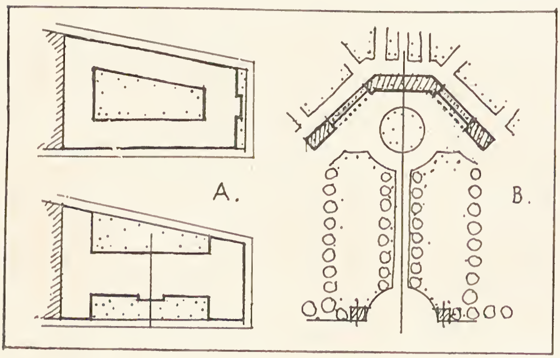

Fig. 4.—Two typical sites

A is an example of a town site, and *B* a more open, unrestricted site. A satisfactory compromise between the exigencies of the site and the requirements of the plan is invariably essential to correct designing.

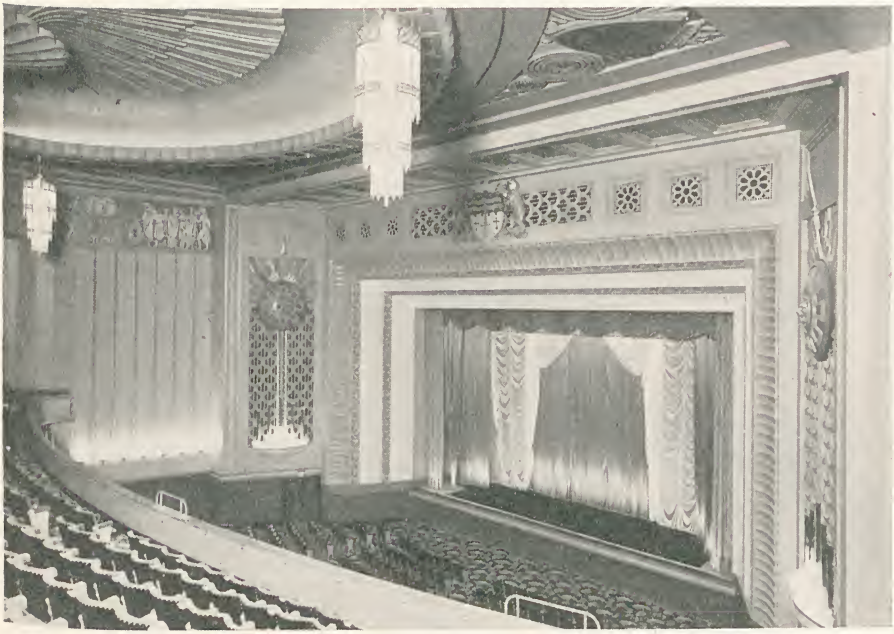

Fig. 4A.—A TYPICAL EXAMPLE OF THE SINGLE-UNIT TYPE BUILDING
Showing the Forum Cinema, Bath, designed by W. H. Watkins, F.R.I.B.A.

Fig. 4B.—ANOTHER EXAMPLE OF THE SINGLE-UNIT TYPE
Showing the interior of the Main Hall of the Reading Corn Exchange, designed by E. S. Smith, F.R.I.B.A.

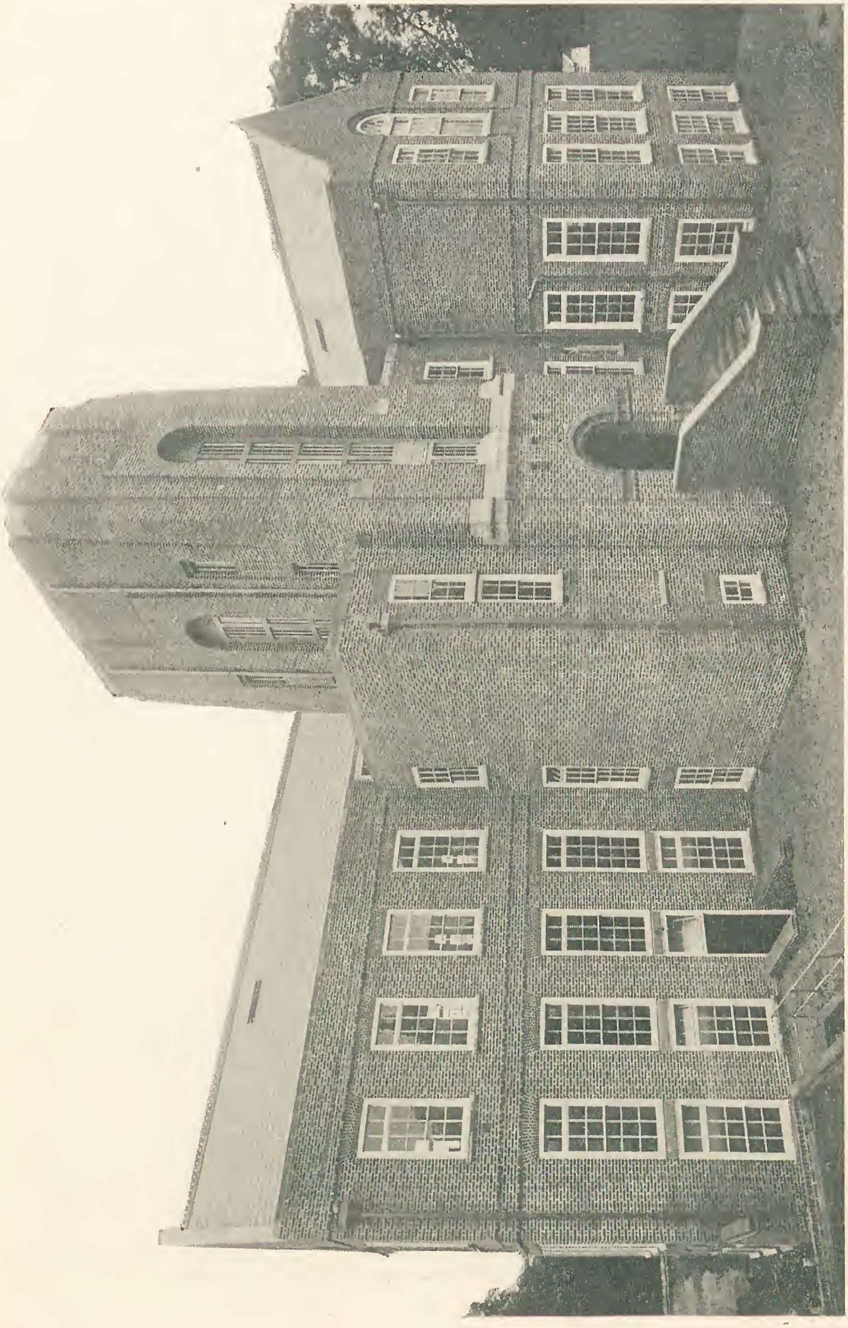

Fig. 4c.—A TYPICAL EXAMPLE OF A WELL-PLANNED MODERN BUILDING ILLUSTRATING THE NUCLEUS, OR PRINCIPAL PART, TOWARDS WHICH THE OTHER ELEMENTS OF THE BUILDING GRAVITATE

This is the Science Building at Leys School, Cambridge, designed by Major C. F. Skipper, F.R.I.B.A.

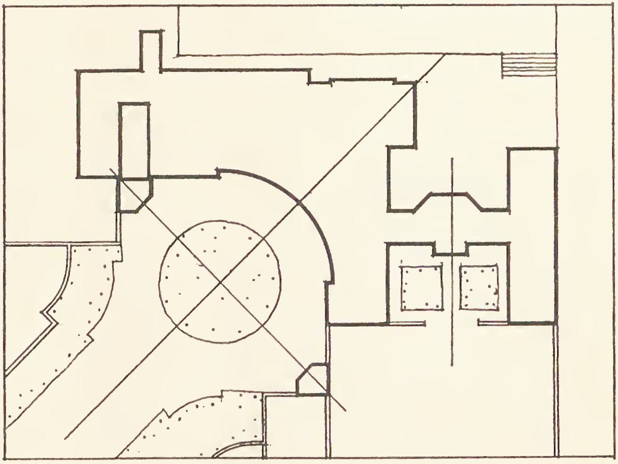

Fig. 5.—A WELL-BALANCED PLAN ON THE MAIN AXIS, YET NOT SYMMETRICAL ON THE AXIS

Balance is present when the various parts of the scheme seem to have the same weight or volume on either side of an imaginary axis. This does not necessarily imply that there is symmetry or identical repetition of similar elements.

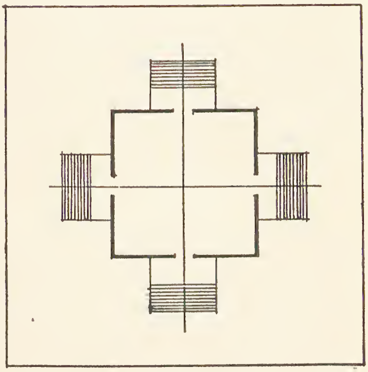

Fig. 6.—(*Below*). A SYMMETRICAL PLAN PRODUCING A SYMMETRICAL ELEVATION

In this case the plan is symmetrical on the main axis only.

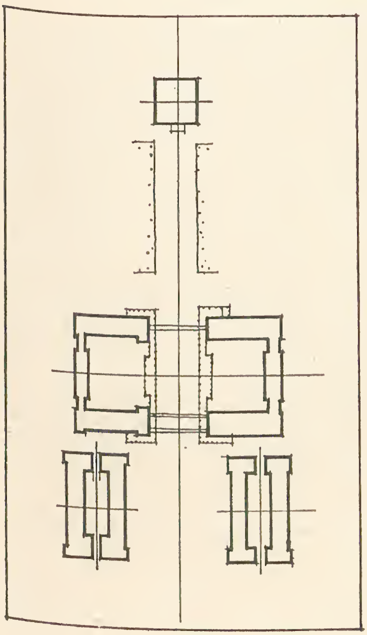

Fig. 7.—(*Above*). TYPICAL EXAMPLE OF A PLAN SYMMETRICAL ON TWO AXES

There may be symmetry on either side of longitudinal and cross axes. In this case the plan becomes square or of forms which may be inscribed in a square or circle.

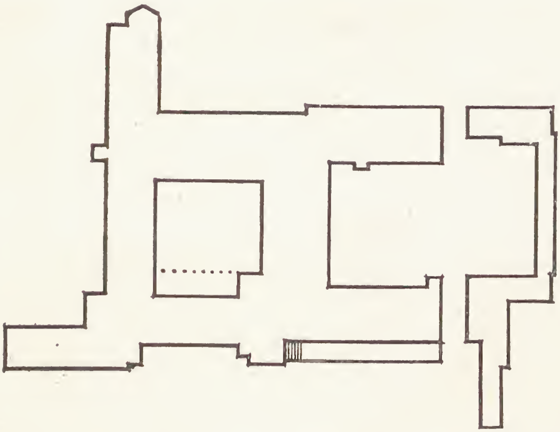

Fig. 8.—A WELL-BALANCED ASYMMETRICAL PLAN

An asymmetrical plan is usually enforced by consideration of restrictions of site, or of efficiency in planning, and in rational design should not be forced merely to produce "novel effect."

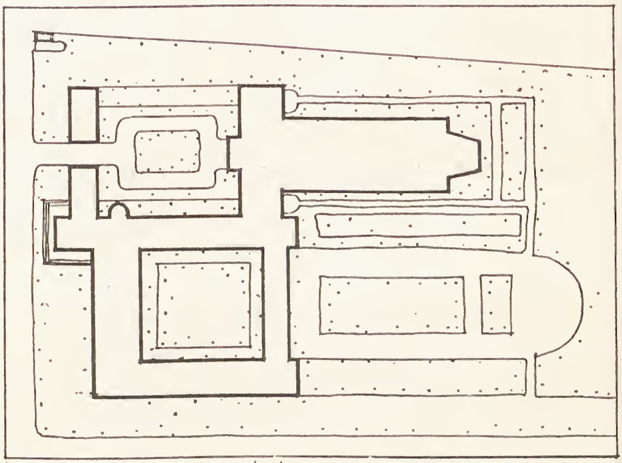

Fig. 9.—AN ASYMMETRICAL PLAN—MONUMENTAL IN CHARACTER

Plans of this type frequently consist of a short and long wing placed on either side of a nucleus on the principal axis.

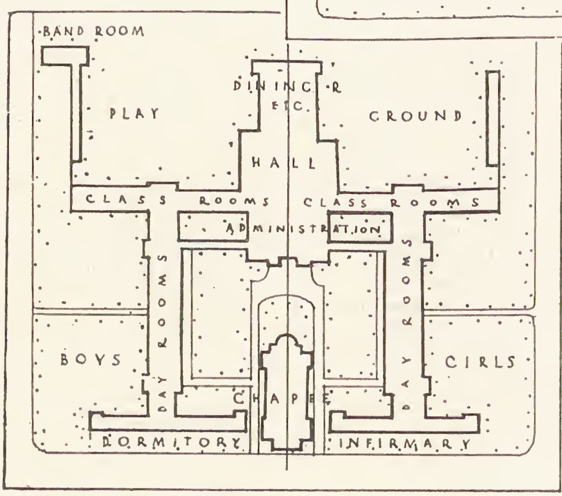

Fig. 10.—A SCATTERED TYPE OF PLAN COVERING A LARGE AREA AND COMBINING SYMMETRICAL AND ASYMMETRICAL PLANNING

A hospital, school or university may be cited as typical examples of this style of planning. There is always present in a plan a nucleus, or principal part, towards which the other elements of the plan gravitate.

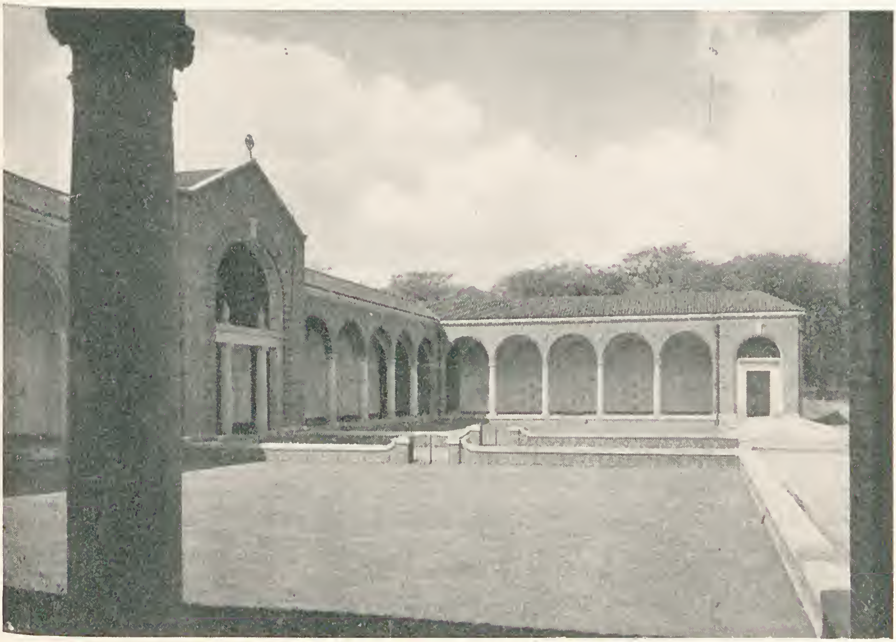

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Fig. 11A.—A BUILDING OF A MONUMENTAL CHARACTER

This is the Columbarium at Lawnswood, designed by C. W. Tomlinson, F.R.I.B.A.

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Fig. 11B.—A WELL-PLANNED BUILDING COMBINING SYMMETRICAL AND ASYMMETRICAL PARTS

The Edge Hill Training College, Ormskirk, designed by Stephen Wilkinson, F.R.I.B.A., A.F.C.

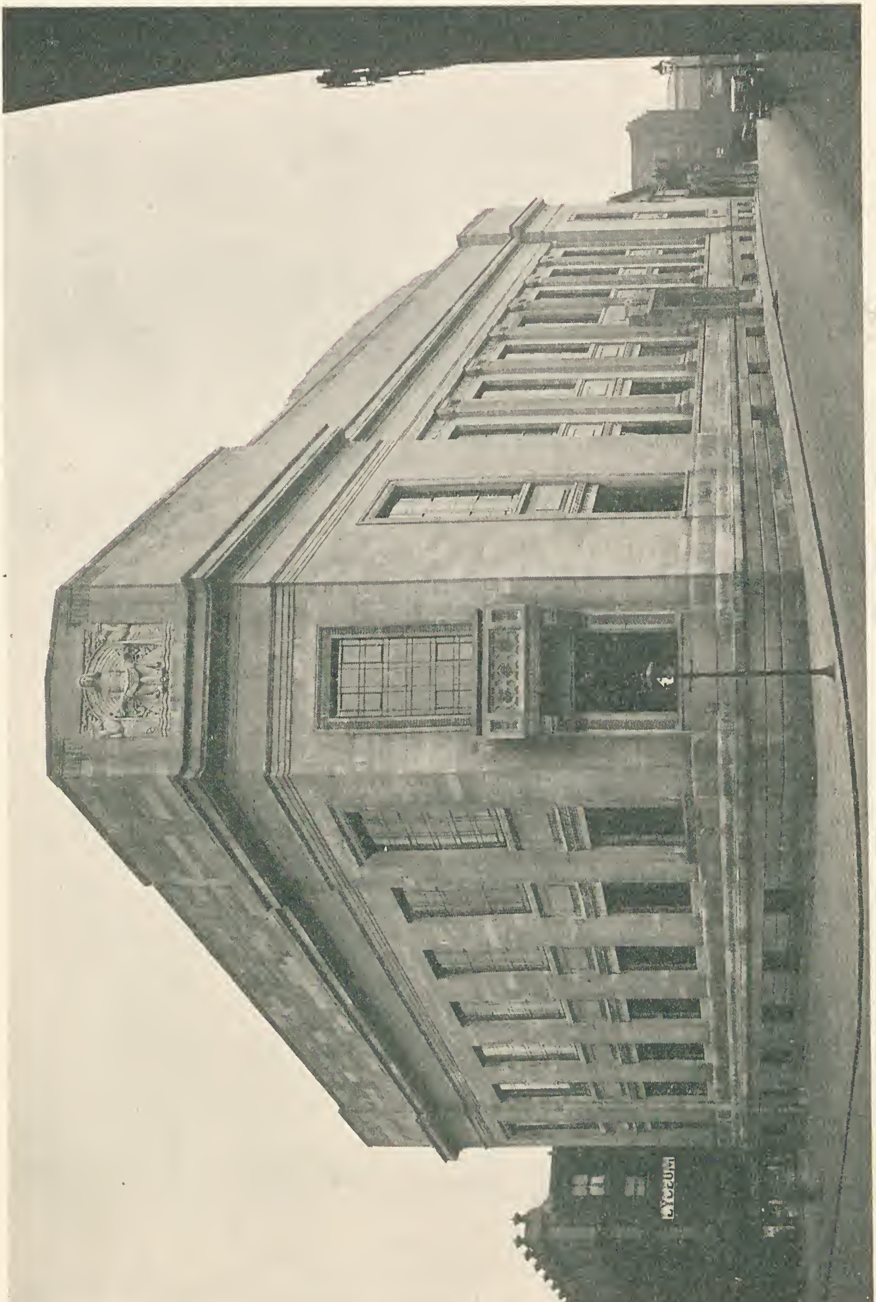


Fig. 11c.—AN EXAMPLE OF A BUILDING IN WHICH DESIGN HAS BEEN INFLUENCED BY CONSIDERATIONS OF SITE

The new Central Library and Graves Art Gallery, Sheffield, designed by W. G. Davies, F.R.I.B.A.

A. Palazzo Riccardi, Florence.

B. Palazzo Strozzi, Florence.

C. Palazzo Riccardi, Florence.

D. Luxembourg Palace, Paris.

E. Palazzo Antinori, Florence.

F. Palazzo Bevilacqua, Verona.

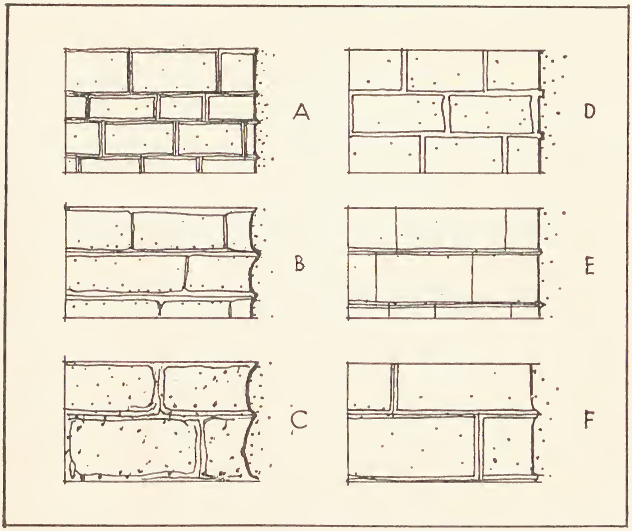


Fig. 11.—Some classical examples of wall texture

The construction of the wall forms a basis of decoration. Texture of material and jointing are all-important. External ornamentation of walls should have relation to the purpose and general character of the building.

A. Villa Caprarola.

B. The Cancelleria, Rome.

C. Palazzo Strozzi, Florence.

D. The Louvre, Paris.

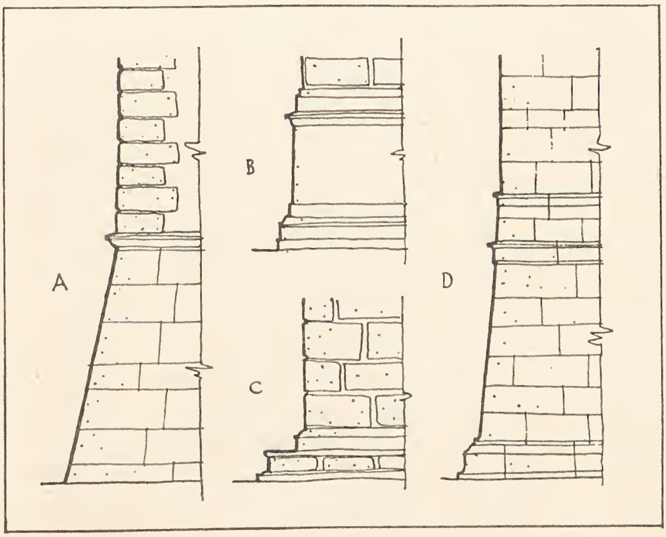


Fig. 12.—Various examples of bases to walls

The lower element or plinth may vary in height, and usually projects away from the building, announcing, as it were, the foundations. This projection must not exceed the projection of the crowning part of the wall whose function it is to protect the wall against weather.

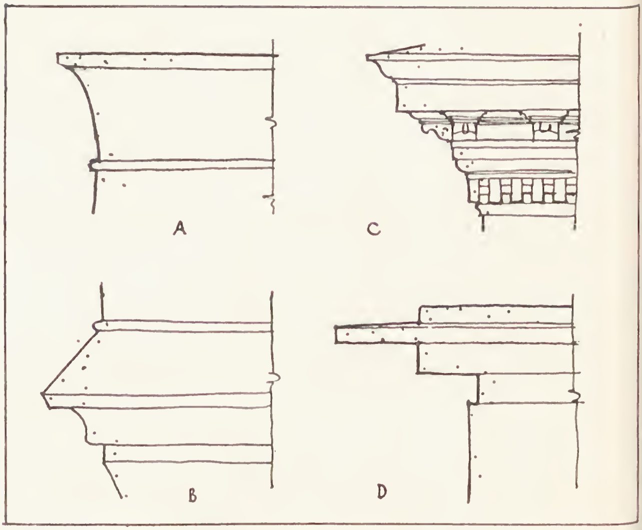


Fig. 13.—TYPICAL EXAMPLES OF CORNICE

A. Egyptian.
B. Mediæval.
C. Renaissance.
D. Modern.

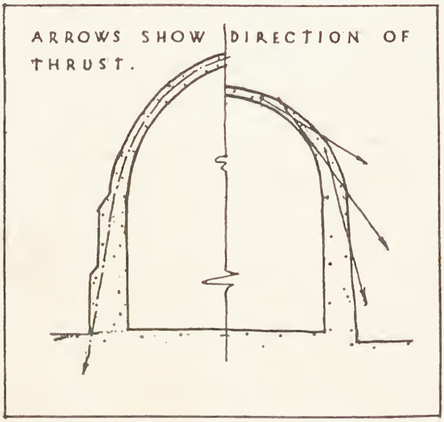
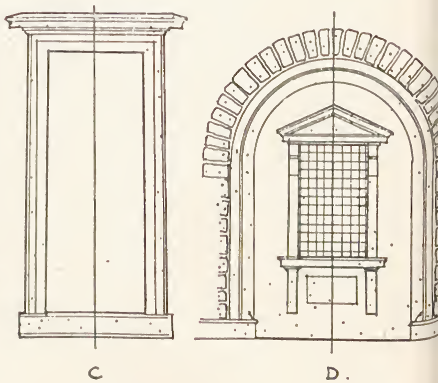


Fig. 14.—(*Left*). SHOWING THE TRANSMISSION OF THRUST BY ARCHES

The horizontal component increases with the flatness of the arch.



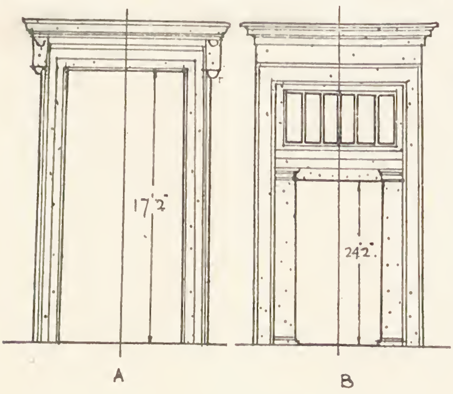


Fig. 15.—(*Left and above.*) EXAMPLES OF RECTANGULAR OPENINGS IN WALLS, AND THEIR TREATMENT

A, Doorway to Erechtheion ; *B*, Doorway to Pantheon, Rome ; *C*, Doorway to Temple of Vesta at Tivoli ; *D*, Window, Palazzo Riccardi, Florence.

FLATS AND COMMUNAL DWELLINGS

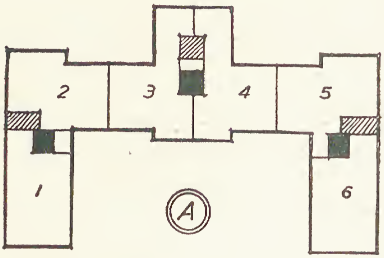
SECTION I. SITES, STAIRCASES, AND LIFTS

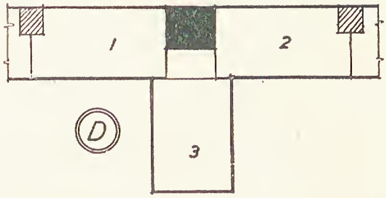
WHILST a discussion as to the pros and cons of communal dwellings does not fall within the scope of this article, it should be realised at the outset that the communal type of dwelling for purposes of rehousing and particularly in congested slum areas is more or less forced upon us in many instances. Opinion is still sharply divided on the question

Fig. 1.—A TYPICALLY MODERN BLOCK OF FLATS. (*Designed by Guy Holt, F.R.I.B.A.*)

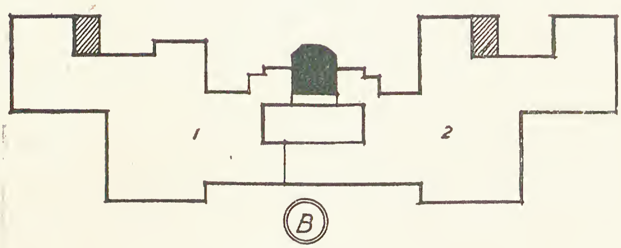
and controversy has raged fiercely round the issue of "flats or houses."

Apart from the question of slum clearance, many people have now decided that a flat is the most convenient type of dwelling to live in if

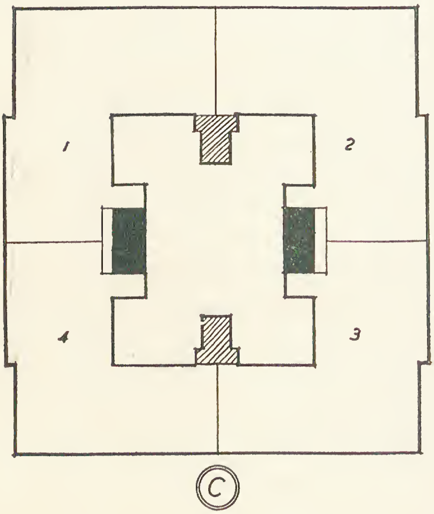


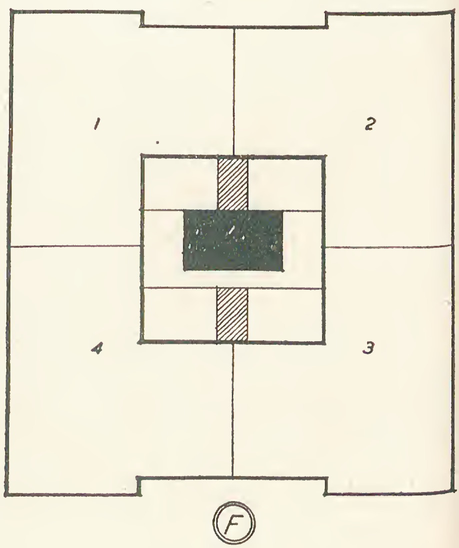


D. Three flats per floor to one main stair; difficult and uneconomic to provide a service stair to the third flat in this arrangement.

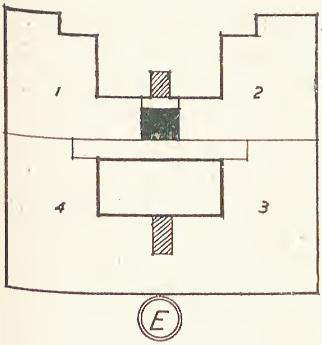


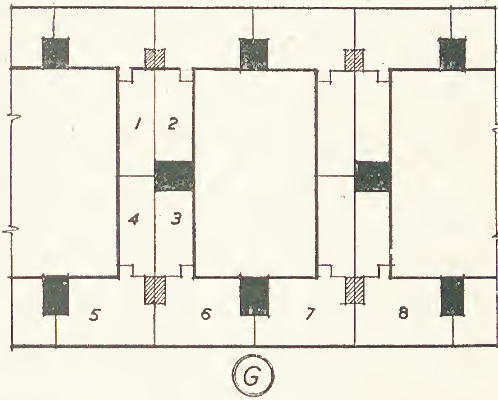
E, F, G, H. Four flats per floor to one main stair; each flat with its own service entrance.

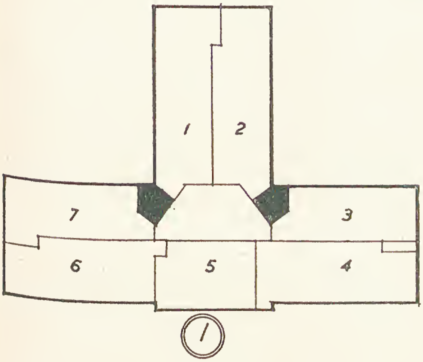




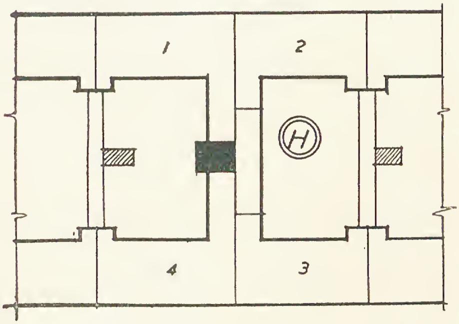
A, B, and *C.* Two flats per floor served by one main stair and each flat having its own service.

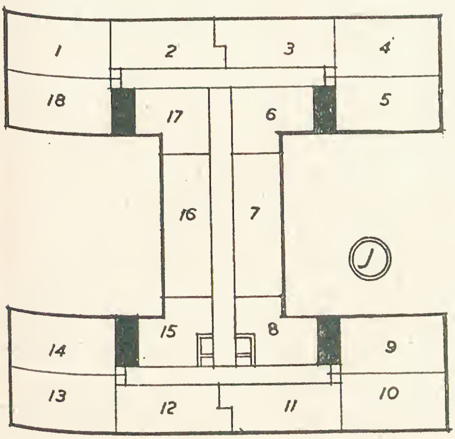






I. Almost a corridor scheme; seven flats per floor served from one main stair. No separate service.





J. Typical central corridor type of scheme.

Fig. 2.—SEVERAL POSSIBLE ARRANGEMENTS OF MAIN AND SERVICE STAIRS IN FLATS AND COMMUNAL DWELLINGS

they work in large towns. Time and money spent in travel are saved and added to leisure; domestic responsibilities and the servant problem are more easily dealt with; maintenance of property and personal liability are limited. There are, of course, quite serious objections to the communal dwelling, to which attention is drawn by the faction who consider that the house is the only form of dwelling suited to the individual of this country. The whole problem is a very complex one, and may never be solved definitely one way or the other. It would appear that both houses and communal dwellings have to be considered in relation to each problem, and the form of development showing the lesser number of disadvantages adopted.

However, the communal type of dwelling is a relatively new departure, and before embarking upon a comparatively new form of housing it would seem important that we should profit as much as possible by past experience; that we should realise that a large block of flats represents a community requiring all the amenities of community life. In short, a new block of flats must embody the most modern ideas and practice. Let us now consider the various factors controlling the design of the flat.

Sites

May be grouped under three main heads, each with planning problems peculiar to itself: (1) Town Sites; (2) Suburban Sites; (3) Country Sites.

Town Sites

Land values are usually high in towns, as there is a great demand for space for business and commercial use. This implies that the rentals of town flats must be relatively high. External traffic noise is a serious problem, and it follows almost automatically that the majority of town flats are small, of the *pied à terre* type for business people, and not family flats.

High ground values enforce careful attention being paid to the relation of ground values to the type of proposed flats and prospective rentals. Again, in the town high ground rents make it imperative to plan as many separate units on the site as possible, as the ratio of profit on revenue from four separate small flats is greater than that on two larger flats. It is of interest to note that rentals are invariably controlled by locality and position rather than by area of accommodation provided. Serious restrictions are frequently encountered on town sites, occasioned by adjoining property, ancient lights, party walls, poor sub-strata for foundations, etc.

Suburban Sites

Consideration must be given in this instance to quite different issues. Access and facilities of transport to business, shopping, and amusement centres are all important. Immunity from traffic noise is essential. Flats suitable for families are usually built in these areas, and the proximity of shopping centres, educational facilities, and amusements is most

Fig. 3.—A BLOCK OF FLATS BUILT IN A CURVE WITH TWO CIRCULAR ENDS, AT ADDINGTON PARK, WEST MALLING, KENT

These were designed by Langley Taylor, F.R.I.B.A., F.S.I.

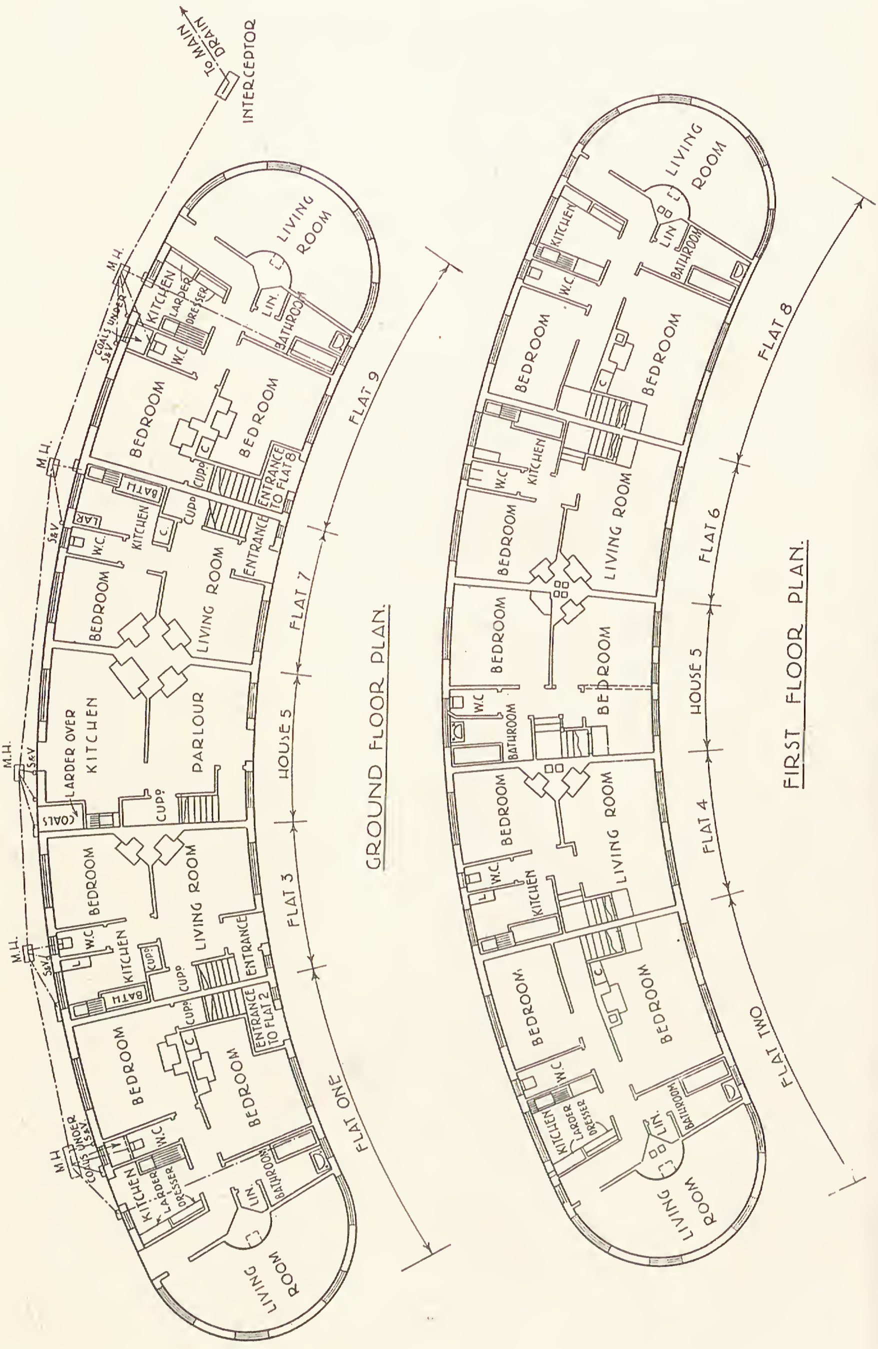


Fig. 4.—Plan of flats built in a curve at Addington Park, West Malling, Kent, and designed by Langley Taylor, F.R.I.B.A., F.S.I.

important. The tendency of the development of the district has to be considered, and is usually more difficult to assess than in the case of built-up areas in the town.

Country Sites

There would appear to be little point in erecting flats in the country, as the real amenities of the flat are lost and houses are usually relatively cheaper. However, it is unwise to dogmatise, as, for example, there are elderly people who may enjoy living in the country without the attendant worry and responsibility of a house and garden.

Aspect

In many cases, and particularly in the case of town flats, the aspect of the site cannot be given full consideration. The shape of the site, the main approaches, possible shopping frontages, etc., all most important, invariably overrule considerations of aspect.

In the case of suburban sites, however, which are usually more open and afford more latitude as to the shape of unit and its spacing, care and thought must be given to aspect. It should be kept in mind that rooms which do not receive any sun are exceedingly depressing, and tenants are much more exacting in this respect than they used to be.

Flats which are built round enclosed areas should not have living-rooms overlooking the area, whilst the area itself should be large enough to permit the sun to reach the lowest flat. This is obviously counsel of perfection and rarely possible in town developments, yet the keen competition in flats to-day debars one from dismissing the matter lightly.

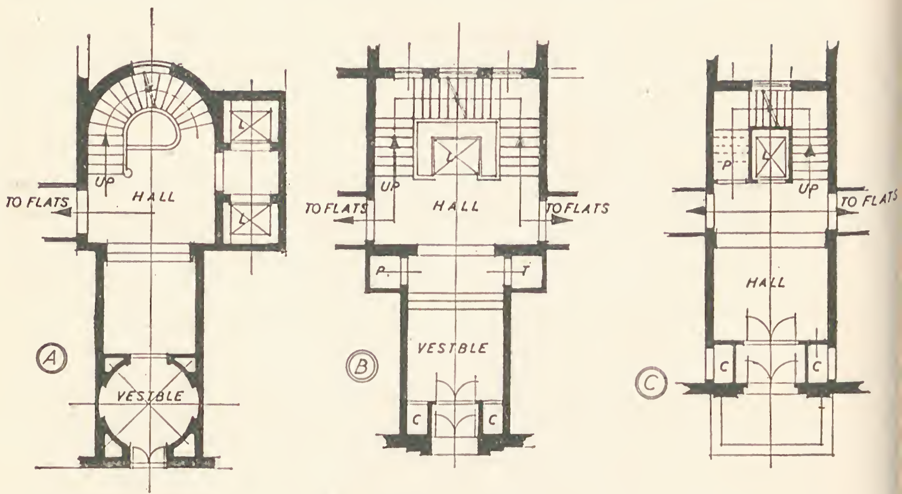
Staircases and Lifts

These should be reduced to a minimum compatible with efficiency. With regard to staircases the authorities usually define the minimum they approve adequate for means of escape. The number of staircases and lifts is, of course, dependent upon the type of development proposed. The principal types may be enumerated as :—

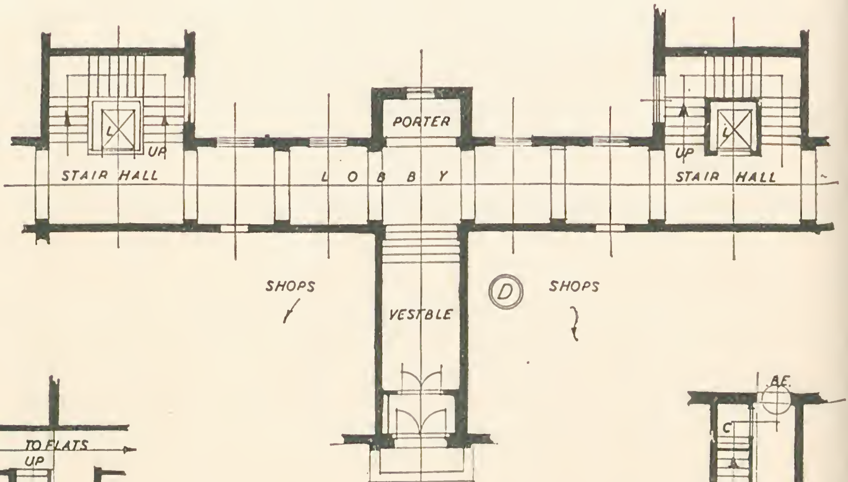
Central Corridor Type of Plan

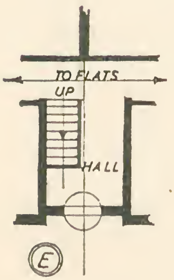
This has flats on either side of a central corridor—an economic arrangement usually found in the case of low-rental types of flat. A minimum amount of non-revenue-producing area is possible under this arrangement, and the cost of staircase work and lift batteries is spread over a larger number of flats. Annual maintenance charges are reduced owing to the small number of points of control.

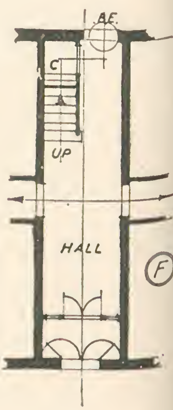
It is, however, difficult to light and ventilate the central corridor other than by means of fanlights over the entrance doors, which are disliked by tenants. A further serious drawback is that the flats themselves



A, B, C. Larger type of hall with accommodation for lift, porter, and permanent supervision. See also *H*.





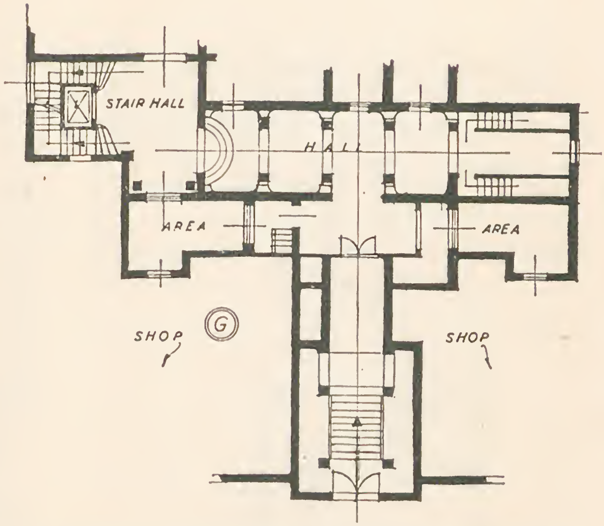


D. Two staircases and lift served by one entrance hall and connected by wide gallery.

Fig. 5.—Several typical entrance halls for flats and communal dwellings

E and *F*. Entrance to low-rental and tenement types.

only have ventilation on one side. The long corridor is apt to become depressing and impart an institutional character to the scheme.



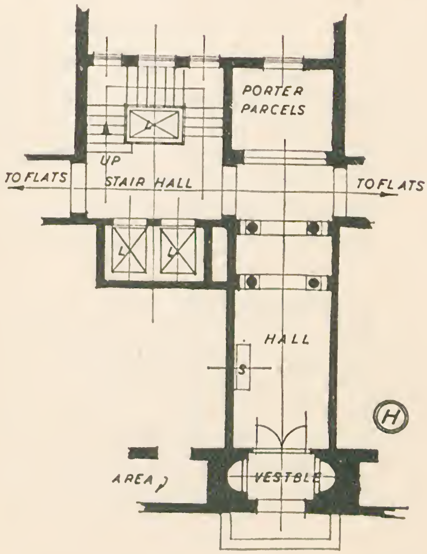
G. Entrance to luxury type or high-rental block of flats.

Group Planning

In this system a few flats per floor are served by one stair and lift. This permits as a rule good light and cross-ventilation to the staircase hall and the flats. Service to individual flats is also possible and can be separated altogether from the main circulation. This is not possible in the central corridor type, and trades and deliveries invariably have to use a separate service stair, which delivers on to the main circulation corridor at each floor level.

This form of plan ensures more privacy for the tenants and lessens external disturbance and noise.

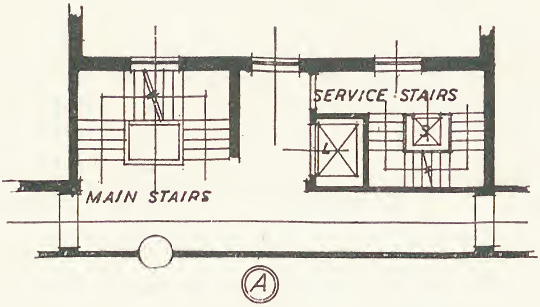
This type of development is, of course, more expensive as a rule, as, owing to the multiplication of staircases, lift batteries, etc., there is a larger amount of non-revenue-producing areas. The increase in the number of points of control must again increase annual maintenance charges. It is usually found that this type of plan allows of more latitude in the planning of the individual flat units.



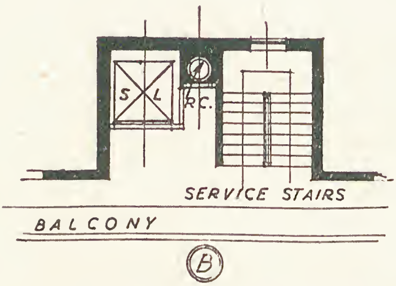
H. Another example of larger type of hall with accommodation for lift, porter, and permanent supervision. See also *A*, *B*, *C*.

External Balcony Approach

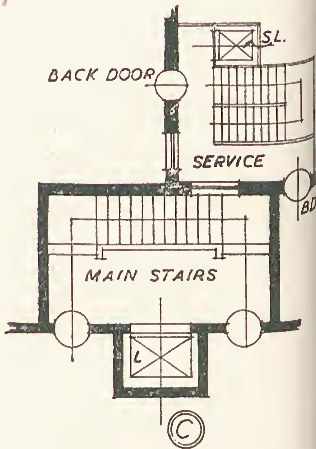
This type of plan is not very desirable except in the case of low-rental flats or tenements. The principal argument in its favour is that of economy, and whilst there



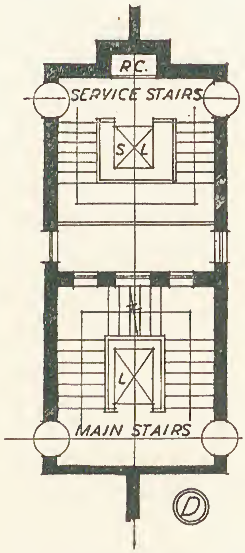
A. Service stair with lift i
well delivering on to main stai
hall at each floor level.



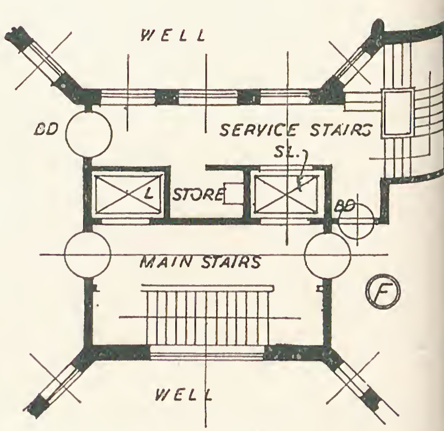
B. External balcony approach giving service to each flat.



C. External service stairs an
lift serving direct to each kitche

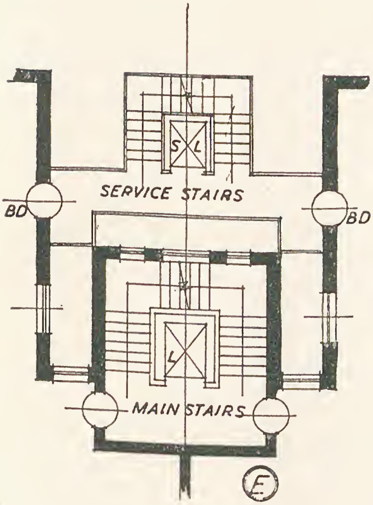


D. As *C*, but placed in open well behind main stairs. Apt to be noisy.

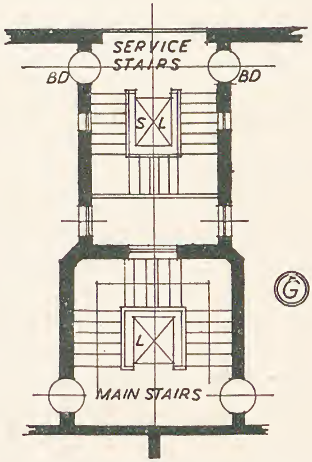


F. Enclosed service stairs and lift servin
a separate service landing on each floor.

Fig. 6.—TYPICAL ARRANGEMENTS OF SERVIC
STAIRS



E. As *D*, but in an open area.



G. As *D*, but in a well open on one side.

are some quite interesting and well-designed blocks of flats planned on this principle, in general a somewhat depressing and tawdry appearance seems almost unavoidable.

Staircase and Lift Arrangements

Fig. 2 illustrates in diagrammatic form various arrangements of staircases and lifts. It will be found that in almost all cases where a block of flats exceeds three or at the most four stories in height, the staircases are considered purely as secondary means of escape in case of fire and for service purposes. This, of course, does not apply in the case of tenements, where a block of five stories in height usually has only a staircase approach, i.e. no lifts.

Some Practical Points

Main staircases should have natural light and ventilation if possible, should be a minimum of 4 ft. in width, and preferably should not contain winders. A carpeted staircase is an asset—reducing traffic noise and imparting a domestic character frequently missing. Lifts should be small and of fairly high speeds. They should be easily seen on entering the entrance hall. Lift shafts should not be placed adjacent to flats. The running of the lift is bound to create a certain amount of noise which can prove very irksome to tenants.

Main Entrance Halls

Careful consideration must be given to the design of the entrance hall. It must be attractive and inviting to the prospective tenant. The plan-

ning, of course, varies with the type of flat. In very low-rental types in which there is no lift, little is found in the way of an entrance hall. Medium-rental types necessitate adequate space for lift, stairs, porter's box, cleaners, etc. Luxury types are similar in general planning though more elaborate in detail.

Location of Lift

The lift may be placed either in the stair well, with the staircase arranged round it, or may be totally enclosed in a separate shaft. The latter arrangement generally produces the best results. Noise and draughts are reduced to a minimum, and the vexatious problem of the lift surround is automatically solved.

The common wire-mesh surround to the lift is very difficult to incorporate into a well-designed interior. Although natural light may be desirable in the entrance hall, it is frequently difficult to obtain sufficient light to avoid a somewhat funereal appearance. In such cases it is wise to design the hall for permanent artificial light. The materials for entrance halls, staircases, etc., must be of a durable nature capable of resisting heavy wear, though at the same time the essential domestic character of the building must be kept in mind. (Fig. 5.)

Service Staircases

These must satisfy the local authorities as regards means of escape in case of fire and usually provide a means of access for tradesmen. Low-rental types of flat do not as a rule have separate service stairs to individual flats. In medium- and high-rental types their provision is essential, and the service circulation must be separate from the main circulation. Service stairs should deliver as near to the kitchen as possible ; this, of course, limits the number of flats which can be served by one staircase.

Refuse bins on service landings should not obstruct the circulation. The service staircases must have natural light and ventilation, and may be placed either on external walls or in open areas. The staircases must be of fire-resisting material and are generally of iron to allow as much light as possible to reach the flats. Iron staircases in an enclosed well or area are, however, generally found to be noisy, whilst in actual fact the open external iron staircase as a means of escape is tending to be frowned upon in London by the authorities. Service stairs should be of a minimum width of 3 ft. 6 in. Fig. 6 illustrates several typical arrangements.

Corridors

Corridors are difficult to light and ventilate ; they increase maintenance costs, and should be reduced to a minimum. An institutional feeling or character is imparted to the scheme unless care is taken with

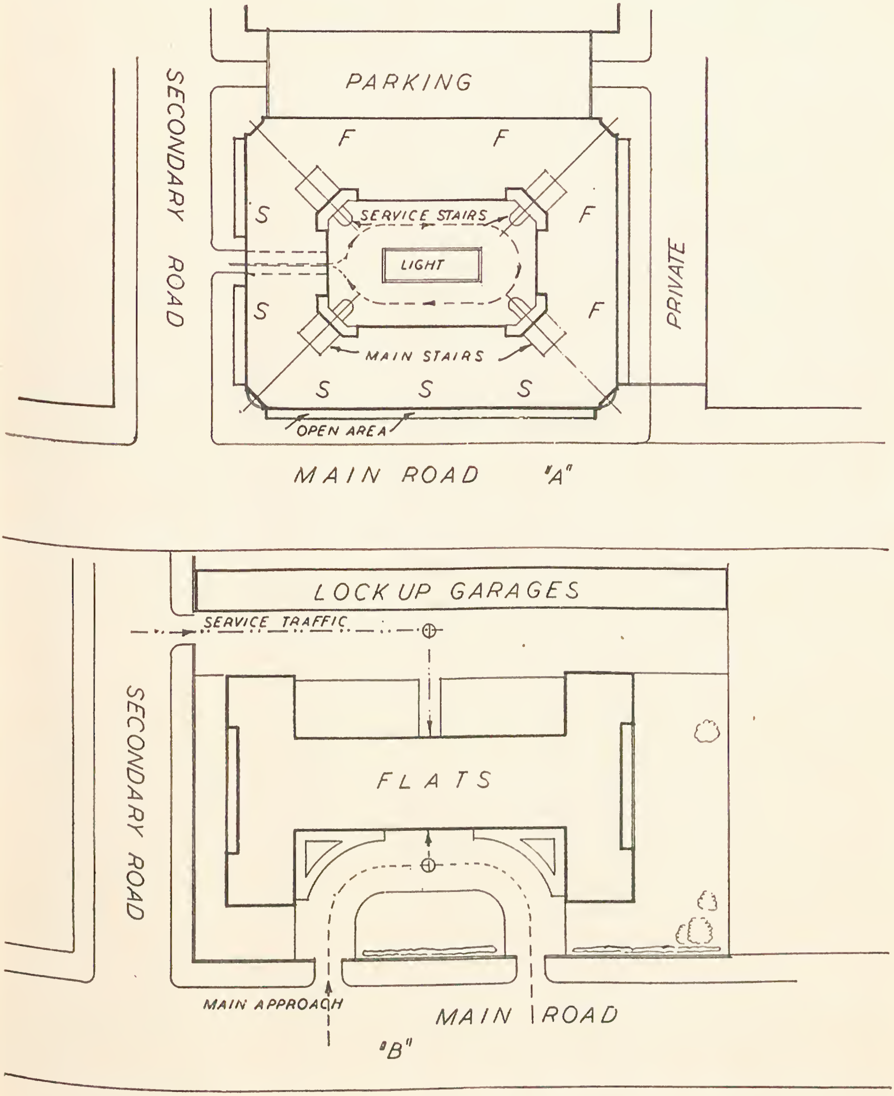


Fig. 7.—Two typical flat sites

A. Block plan of typical town site developed right up to the back of the pavement with shops along the main frontages. *B.* Block plan of a more open development with part of the site laid out as gardens.

long corridors. No corridor should be less than 4 ft. wide, whilst 5 ft. is better. A wide corridor facilitates the handling of furniture, and reduces damage to walls, etc.

A corridor must provide alternative means of escape in case of fire, and to do so must not cross staircase halls. Staircase halls must be cut off by fire-resisting doors. In the case of the central-corridor type of plan it is a good idea to endeavour to stagger the entrance doors to individual flats, to afford as much privacy as possible to tenants under somewhat limited conditions.

Heights of Flats, etc.

There would appear to be no logical reason for limiting the height of blocks of flats to any specific height providing adequate lifts and means of escape are provided. In actual fact several factors control the height of a block, namely: the authorities, by means of fire regulations, by-laws, etc.; ancient lights surrounding the site which establish the permissible height irrespective of the possible height; town-planning restrictions now making their presence felt—in London at least!

Heights of rooms of course establish the height of the block. A height of 9 ft. from floor to ceiling is seldom exceeded, except perhaps in luxury types of flat. To-day the problem is invariably that of placing the maximum number of stories upon a given site, thus necessitating the minimum floor heights permitted by the authorities. This is without doubt one of the several aspects of flat development which will benefit from the control of town-planning regulations.

Portions of the Site not Built Over

It is frequently found that a large portion of the site is not built over, and particularly in the case of sites which are situated in an area scheduled under a town-planning scheme. In this case only one-third of the site is frequently available for building upon to conform with the regulations.

The treatment of the remaining portion of the site varies according to the type of flat (Fig. 7). In the case of tenement schemes the area may be closed to traffic and used as a children's playground. High-rental types of flat usually provide a certain amount of garden for the enjoyment of the tenants. This, of course, only applies to fairly open types of site. Restricted sites in the town call for quite a different form of planning.

Restricted Sites

In the case of sites situated in the town it is frequently necessary to develop the site right up to the pavement or building line. This creates several problems aggravated by the fact that ground values in such cases are invariably high. Ground-floor flats are as a rule disliked by tenants,

Fig. 8.—An attractive arrangement of shops with flats above, at Water Lane, Wilmslow, Cheshire, designed by Messrs. Oakley and Sanville

and particularly in towns. This dislike is based upon a fear of burglary and of being overlooked. It is found, in fact, that ground-floor flats in the town do not let well.

If at all possible the placing of shops on the ground floor, and particularly in busy thoroughfares, can prove very lucrative. The position of the site in relation to shopping facilities must of course be considered before such a decision is arrived at. This is not always nearly so easy as it may appear. It may, for example, be found that one side of a street is much better than the other for shopping without any apparent reason at all. Isolated shops are almost sure to be a failure. A development in these circumstances usually involves devoting the whole of the ground floor or basement (if any) to shops, except the areas necessary to provide services and entrances to the flats over.

Flats over Shops

Providing that suitable trades are selected, there is no objection to placing flats over shops. The shops should be of the same relative quality or type as the flats over.

In the suburbs basements are not as a rule provided, as there is generally ample space at the rear of the site for storage purposes. Similarly, it is usually found that the shops selected have a width

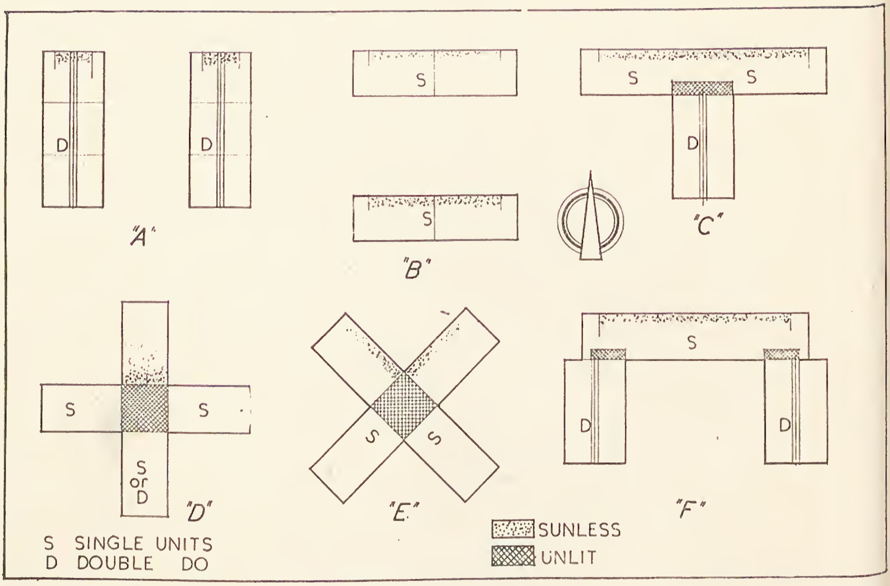


Fig. 9.—IN THE CASE OF SUBURBAN SITES MORE LATITUDE CAN BE GIVEN TO THE SHAPE OF UNIT AND ITS SPACING.

Flats which are built round enclosed areas should not have living-rooms overlooking the area, whilst the area itself should be large enough to permit the sun to reach the lowest flat.

which will allow of an economic single flat being placed over it. The flat is usually of the maisonette type with external balcony approach.

Span of Shop Front

The size of the shop in suburban developments is usually from 16 ft. to 24 ft. in span. A larger span is not advisable, as it tends to cause subdivision of the shop front, usually in an unsatisfactory manner, and also makes the flat above too large. It must be remembered that in this type of scheme the shop tenants usually inhabit the flat over the shop. This restriction does not as a rule apply in the town, where the flats over may bear no relation at all to the shops. More expensive streets may have shops only 12 ft. in span.

A later article deals with the design of entrances and interiors of flats.

TOWN HALLS

PRACTICAL NOTES ON DESIGN AND PLANNING

DURING the post-war period there has been remarkable activity in the building of town halls, and as, except in the case of a metropolis, this type of structure is usually the most important in the city, no excuse need be made for starting a series of articles on modern building practice by an attempt to analyse the nature of the difficulties which are encountered by the designer of a town hall.

The Architectural Problem

This architectural problem, like all others, has two principal aspects, that of the plan and section and that of the elevation. There has been a tendency in recent years rather to belittle the importance of the elevation and to argue that if only we look after the plan first and devise a convenient and logical arrangement of the rooms, then the elevation can be safely left to look after itself. This is the extreme "functionalist" point of view, and there is something to be said for it if we are dealing with a factory belonging to a private owner in some part of a town where its relationship to other buildings is not very important and where it may be assumed that the owner of the building is free to follow the precept of "doing what he likes with his own." But in the case of a town hall the matter is quite different. The building is being erected at the expense of the ratepayers, and they expect to see an example of civic architecture in which they can take pride and which obviously adds to the dignity of their native town. The fact that the town clerk can communicate with the various municipal departments with the minimum expenditure of time, or that the technical equipment of the building is beyond criticism, matters little to the ordinary citizen. What interests him most is the outside of the building.

What the Policeman Said

This point can perhaps be best illustrated by the following story. A few years ago those responsible for the government of an important English city decided to institute an architectural competition for the best designs for a great group of municipal buildings. In due course, with the usual great expense and labour to the architects concerned, a hundred or more beautifully produced sets of drawings were submitted to the assessor,

and in accordance with an excellent practice the designs were displayed for everybody to see in a public gallery. The present writer visited this exhibition with the object of writing a critique of the designs, and thinking that it would be of value to obtain the opinion of an independent citizen not himself claiming to be an expert in architecture or its allied studies, he ventured to interrogate one of the policemen engaged in superintending the gallery. It so happened that the author of the winning design had shown an exceptionally brilliant plan. Where the other competitors had floundered, he alone by a stroke of genius had arrived at that ideally simple yet elegant arrangement of rooms, which every architect knows to be the mark of a master planner. But the policeman was not impressed. He complained that the building did not look like a town hall " because it had no tower." Surely the policeman was right.

A Practical Question

There should be some visible symbol of the dignity appropriate to a town hall, and if this symbol does not " grow out of the plan " it must be introduced in accordance with some standard of design which supplements the " functionalist " standard. That this particular policeman's view was not a private and eccentric one, but was fully representative of an influential section of the citizens, was proved by the fact that a few years later, owing to the pressure of public opinion in the locality, the municipal authorities decided that the new town hall should be adorned with a tower. The foregoing story shows that the question relating to these architectural symbols of state is a really important one and no designer of a town hall can afford to neglect it. It is idle for any critic to say that this issue is not *practical*. A practical issue may be defined as one which we cannot neglect without getting into trouble. As an example of the kind of trouble which may result from the too strict observance of the " functionalist " philosophy, one may cite the following case of the assessor of an architectural competition for the best design for a town hall. His award was set aside by the municipal councillors. They preferred a design other than the one placed first by the assessor, on the ground that it more obviously expressed the idea of civic dignity.

Not a Matter of Style

Thus it is just as important to pay regard to the outside of a town hall as to the inside. What are these external characteristics which the ordinary citizen has a right to expect in a town hall, and how can the designer of this type of building associate the architectural symbols of state with the most convenient and economical plan ? One can discuss this particular problem without taking sides in the old battle of the architectural styles. In order that a town hall should, in the popular estimation, look like a town hall it is not in the least necessary that it should be designed in what is known as the Classic style. On the other hand, it is only fair to state that the adoption of this style is by no means

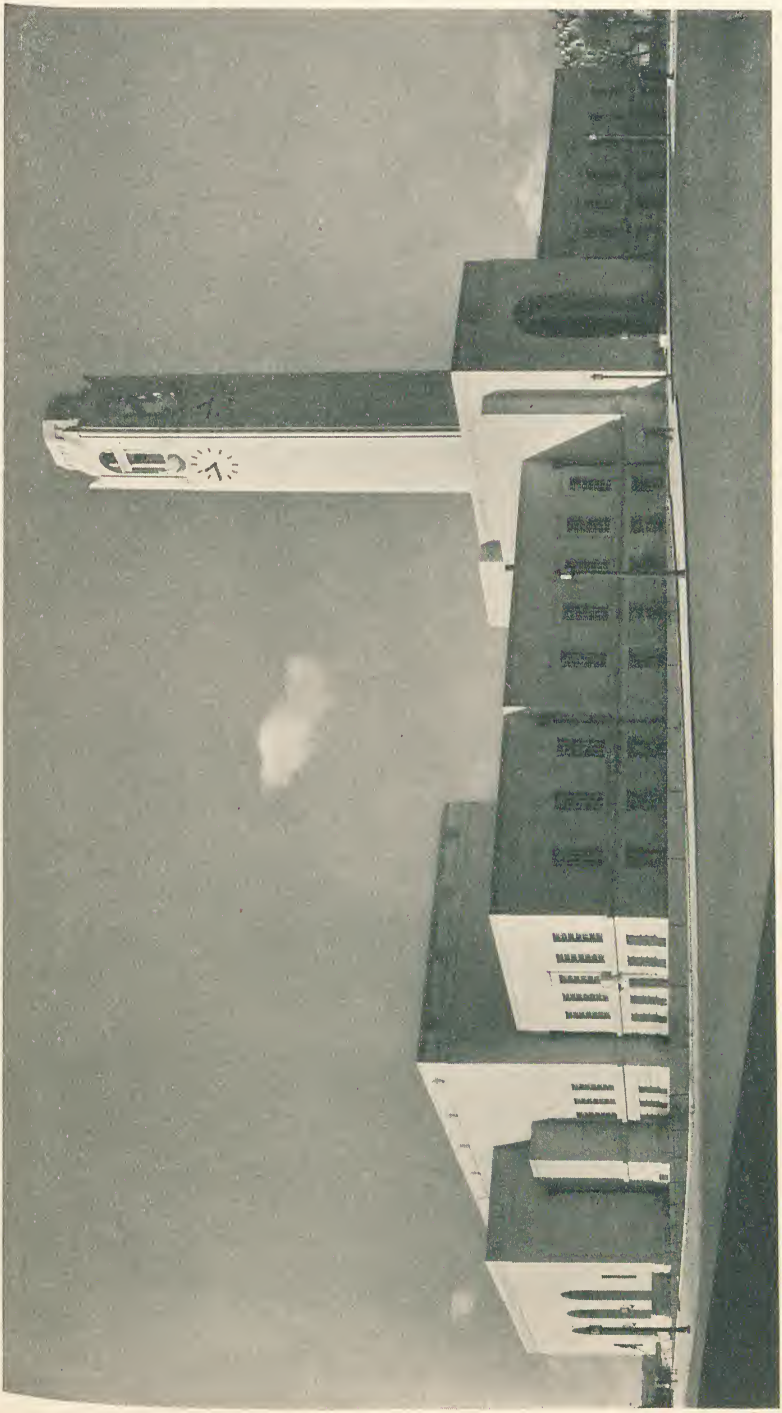


Fig. 1.—SWANSEA CIVIC CENTRE

Assembly Hall and Council Suite Buildings. View showing clock tower and arched main entrance. (*Architect—Percy Thomas, O.B.E., P.R.I.B.A., of Messrs. Ivor Jones & Percy Thomas.*)

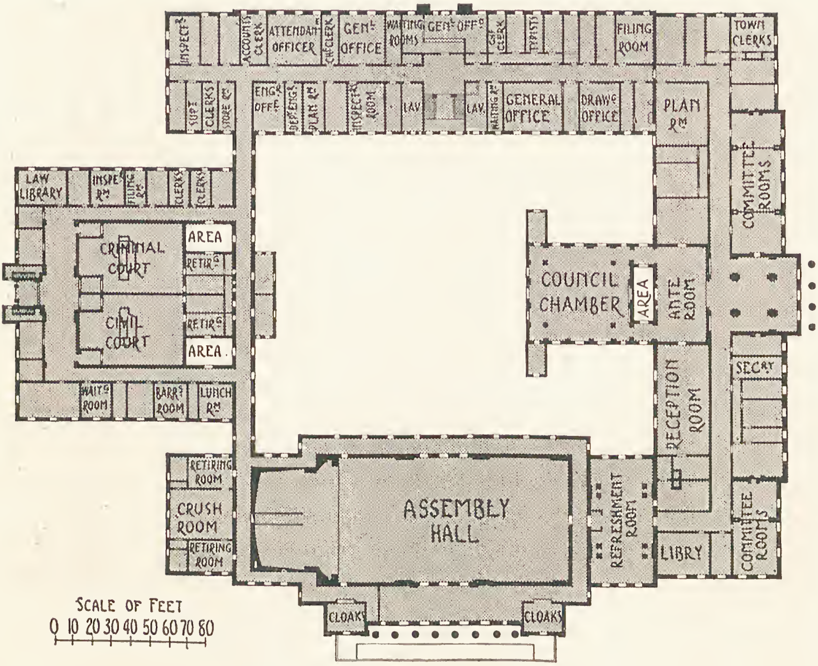


Fig. 2.—SWANSEA CIVIC CENTRE

Upper ground-floor plan, showing circulation between Council Chamber, Assembly Hall, Law Court, and Municipal Offices. (*Architect—Percy Thomas, P.R.I.B.A.*)

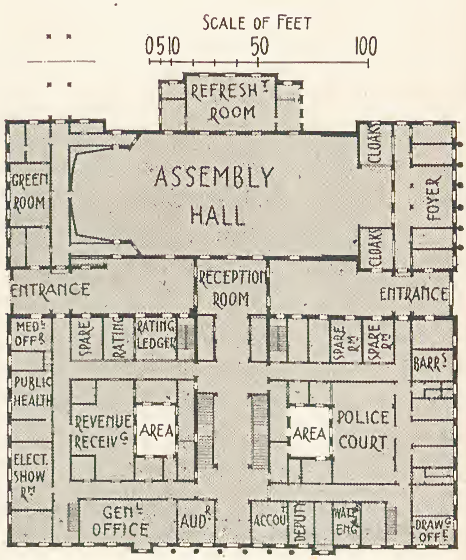


Fig. 3.—WORTHING TOWN HALL

First-floor plan, showing Municipal, Offices and Police Courts on either side of approach to Assembly Hall. (*Architect—C. Cowles-Voysey, F.R.I.B.A.*)

Fig. 4.—SOUTHAMPTON CIVIC CENTRE

View showing clock-tower behind entrance to Police Courts. (*Architect—E. Berry Webber, A.R.I.B.A.*)

Fig. 5.—WORTHING MUNICIPAL OFFICES

View showing pedimented main entrance surmounted by cupola. (*Architect—C. Cowles-Voysey, F.R.I.B.A.*)

Fig. 6.—CIVIC HALL, LEEDS

Pedimented main entrance flanked with spires. (*Architect—E. Vincent Harris, O.B.E., F.R.I.B.A.*)

Fig. 7.—MUNICIPAL OFFICES, BECKENHAM, KENT

Principal façade, showing domed tower, above main entrance. (*Architects—Lanchester, Lucas and Lodge, FF.R.I.B.A.*)

a bar to this correct civic expression, and that, in point of fact, some of the recent town halls which are universally acknowledged to be not only supremely well planned, but acceptable to the public in other respects, have been designed in this manner.

Symbols of Civic Dignity

The essential thing about the elevation of a town hall is that it should exhibit some feature sufficiently prominent for it to dominate over buildings of lesser social consequence than itself. Such an end is certainly accomplished if some part of the town hall be noticeably higher than the surrounding buildings. It was an appreciation of this fact that led to the policeman's very sensible demand for a tower. Such a tower may be brought into the category of useful and functional elements by being made to hold a clock, but nowadays, when nearly everybody can consult a watch, this functional attribute of the town hall tower cannot be said to be an adequate justification for it.

It is of great interest to observe the various ways in which the architectural quality especially suitable for a town hall is achieved in examples of this type of building recently erected in England. Municipal towers are to be found in the following examples: Norwich, designed by C. S. James and S. Rowland Pearce (this form is rather reminiscent of the famous town hall of Stockholm); Swansea, by Percy Thomas of Messrs. Ivor Jones and Percy Thomas; Hornsey, by Reginald H. Uren (a modernist example); Beckenham, by Lanchester, Lucas and Lodge; Southampton, by E. Berry Webber, and, to take a pre-war instance, Cardiff, by Lanchester and Rickards. The design of an appropriate tower form for a town hall is a fascinating study. The architect has to steer clear of the type of treatment usually associated with a church and, on the other hand, he has to be extremely careful not to make his tower so slender and so lacking in decorative shape that it resembles a factory stack. In some of the instances quoted the tower is supplemented by a pediment which marks the entrance to the building as a whole, or to one section of it, such as the Assembly Hall or the Law Courts. An exceptionally fine instance of the pedimented style is to be found in the Civic Hall at Leeds, by Vincent Harris. In other cases the requisite architectural dignity is in part achieved by an imposing arched entrance, as in the case of Swansea. An English traditional method is to have a flèche on top of a high-pitched roof. This practice is exemplified in the London County Hall. At the present moment there is no universally recognised method of giving to a town hall its appropriate dignity. Yet the general public insist that this object shall be achieved to its satisfaction in one way or another. If the average citizen declares that a new block of municipal offices "looks like a factory," this implies a perfectly sound criticism of the building in question, and the architect must take note of it. The question of the

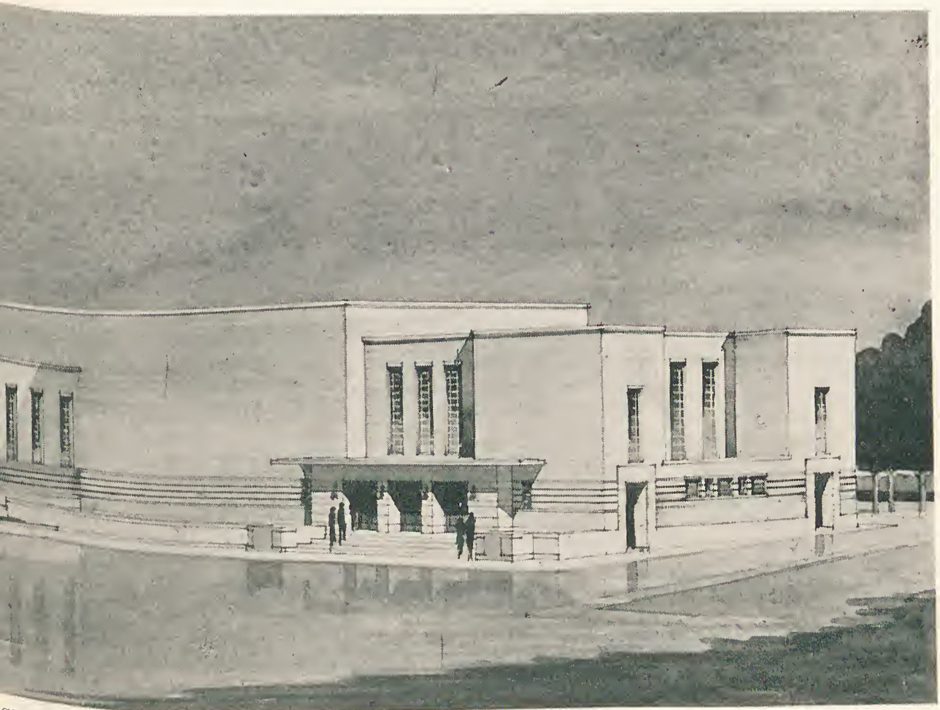
Fig. 8.—DESIGN FOR MUNICIPAL

Illustrating a modern trend, this building is faced with light silver-grey facing bricks vertical brick joints fitted flush—all in "garden-wall" bond. The stone dressings are in

proper elevational treatment of a group of municipal buildings can be discussed in further detail when we come to consider the plan.

The Council Chamber

A modern group of municipal buildings comprises the following elements—the council chamber, the mayoral suite, the municipal offices, the assembly hall, and the law courts. Let us first consider the council chamber itself. Even in a large city the number of councillors is not very great, and the chamber where they meet for their discussions is of comparatively small dimensions. Owing to the fact that in most instances (Cardiff being one of the most notable exceptions) the town hall group is in the built-up portion of the town and is surrounded by a stream of traffic, it is desirable either to make it face an interior court or to give it a top light. It has occurred to the present writer that in these days of lifts it might conceivably be possible to elevate the council chamber so that it is in fact the highest part of the building. It would thus be raised above the traffic noises, and if its exterior could be given a decorative shape in accordance with a convention which would be recognised



SSEMBLY HALL, ROMFORD, ESSEX
rick rustications. Horizontal joints kept $\frac{3}{4}$ in. wide and raked clean to $\frac{3}{4}$ in. back and the
tone. (*Architects : H. R. Collins, F.R.I.B.A., and A. E. O. Geens, A.R.I.B.A.*)

by the "man in the street," we might arrive at a solution of the problem of giving suitable external expression to the town hall group in a manner which would give greater satisfaction to the functionalists than does the practice of adding a tower having no obvious usefulness. A suitable feature in a council chamber so placed would be a balcony from which the councillors could survey the area of their jurisdiction. In association with the council chamber there must be separate retiring-rooms for councillors of either sex.

For the layout of the council chamber several solutions have been devised. The most commonly used are the semi-circular and the horseshoe types, for these provide a good view for everybody in the room. More rarely a circular or an elliptical type is chosen, but these have the disadvantage that the seating is not inflected to give formal emphasis to the position of the mayor and other chief officials of the council. Yet a fifth type, especially suitable for large towns where the number of councillors is more numerous than in most instances, is the House of Commons type, with the familiar arrangement of the contending political parties facing each other. The entrances to the council chamber present some

difficulty. If the members' lobby, from which entrance to the chamber is usually made, is next to the side of the council chamber at which the mayor's seat is situated, he is apt to be disturbed by late-comers walking to their seats. If the entrance is on the opposite side, the mayor is obliged to walk the whole length of the chamber in order to take his seat. The ideal arrangement would seem to be the provision of a corridor right round the council chamber, giving approaches to it from all sides. Such an arrangement would be quite possible if the proposal for a raised council chamber, which was mooted in the previous paragraph, could be adopted. The council chamber has to provide accommodation for the deputy-mayor and the town clerk to sit on either side of the mayor, the aldermen and councillors, and various permanent officials and the Press. In addition there must be a small public gallery, access to which should be from an entrance on the ground floor, where some control could be exercised upon those going in. The ante-room to the council chamber is an important apartment, having the characteristics of a foyer in which members can meet in an informal manner before and after the council meetings.

The Municipal Offices

It may be a convenient procedure if the department of the municipal offices is considered next. One of the most important departments is, of course, the rates office. This should have a large counter space to which the public has convenient access. Usually this office is on the ground floor, and is approached from one of the principal entrances to the building. Associated with it are a general office for clerks, an interview room, rooms for general inquiries, and private offices for the accountant. Adjacent to this department there should also be a strong room. Other departments, for which office accommodation must be found, are those for valuation, surveyors, engineers, and architects. As the drawing offices should be especially well lit, it is a good arrangement if these latter can be placed on an upper floor with top lights. Then the medical officer of health must have ample accommodation, which should include a small laboratory.

The chief permanent official is the clerk to the council, and he and the deputy clerk and their attendant secretaries and typists should have a suite of rooms adjacent to the committee rooms. In recent years a department of the municipal offices which has grown very considerably is that of public assistance. This department, however, is usually separate from the municipal offices. A number of smaller departments are usually to be found in the block of the municipal offices, namely, those administering markets, shops, allotments, parks, waterways, and the registration of births, deaths, and marriages. The weights and measures inspector has an office with easy access from the street. Addressograph machines are best placed in the basement, where they may be insulated against noise.

The Committee Rooms

An important element of accommodation is the group of committee rooms. It is customary that, like the council chamber, these rooms should be vested with a certain measure of architectural dignity, for a good deal of the actual work of government of the municipality is performed here. One of these committee rooms must be large enough to take the whole council. As the members of committees need to make fairly frequent reference to officials in the various departments of the municipal offices, it is desirable that the committee rooms should be within easy reach of the quarters occupied by the town clerk, the surveyor, the medical officer of health, and other officials. But there is no necessity for the committee rooms to be next to the council chamber. Usually as these rooms are of a height considerably greater than that which is considered necessary for the municipal offices, they provide an opportunity for an elevational treatment whereby this suite of rooms is given a special architectural importance. It can thus very properly be placed on the main front of the building and so contribute to its formal impressiveness.

The Mayoral Suite

The mayoral suite comprises a private room for the mayor and mayoress and, where the municipality is a very important one, one or more reception rooms for guests and distinguished strangers. In former days, when municipal entertainment was on a more lavish scale than now, the Mansion House type of plan was adopted, with a grand ceremonial room set aside for this purpose, but to-day the usual practice is for the mayoral suite to be adjacent to the committee rooms, so that these latter can be used for entertaining visitors. One of the duties of the mayor is on certain occasions to make public pronouncements ; for instance, the results of Parliamentary elections are usually made known from a balcony over the entrance to the town hall. This balcony, therefore, might very well be considered a characteristic feature of a town hall, and in order that its function as a rostrum should be adequately performed it is desirable that there should be a reasonably large open space in front of it for the assemblage of a crowd. Occasionally, the mayoral suite contains a banqueting hall and luncheon room, but nowadays, when large companies of guests are entertained, the assembly hall is also called into requisition. It is therefore desirable that if possible this should be adjacent to the mayor's suite.

The Assembly Hall

The provision of a large assembly hall available for public use in connection with objects other than that of municipal government is of comparatively recent practice. This important element in the modern group of municipal buildings has now come to be considered essential, and the conditions which require to be satisfied in the planning of it become

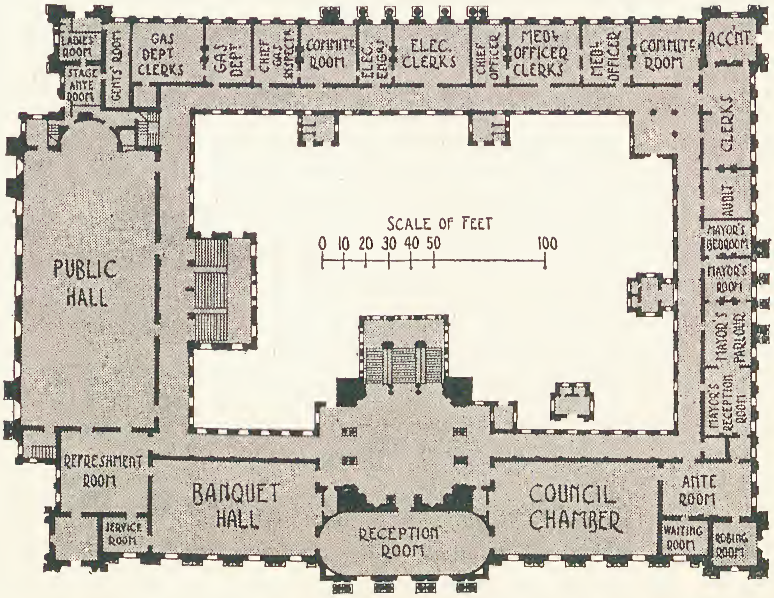


Fig. 9.—Belfast city hal

First-floor plan, showin Municipal Offices, Publi Hall, Banqueting Hall, an Council Chamber. (*Architec —Sir Brumwell Thoma F.R.I.B.A.*)

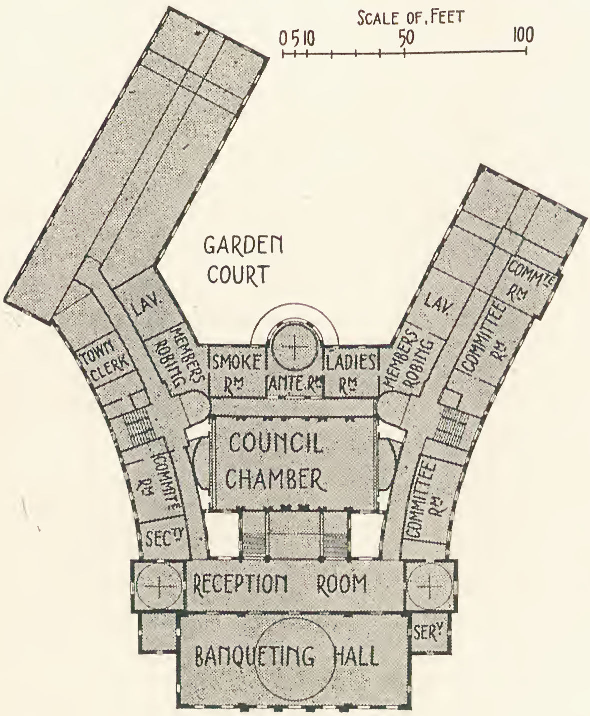


Fig. 10.—Leeds civic hal

First-floor plan, showin Council Chamber, in centr of building, Banquetin Hall, and Municipal Office (*Architect—E. Vincen Harris, O.B.E., F.R.I.B.A*

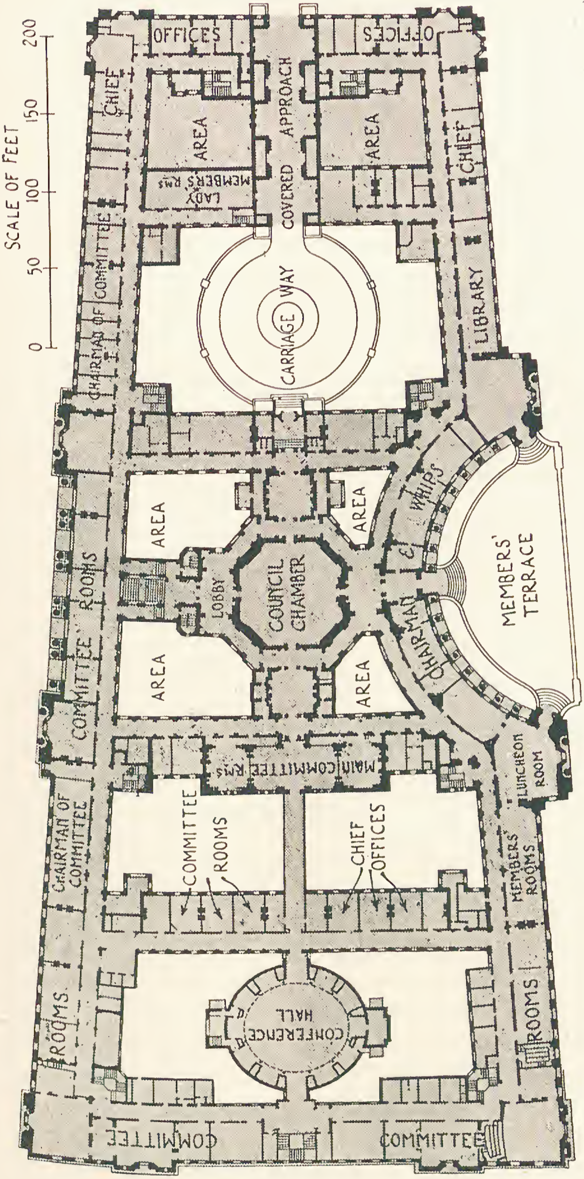


Fig. 11.—LONDON COUNTY HALL

First-floor plan, showing top-lit Council Chamber, Conference Hall and Committee Rooms in interior court, Municipal Offices, and Members' Terrace. (*Architect*—*Ralph Knott, F.R.I.B.A.*)

ever more various and complex. The assembly hall should not only be suitable for public meetings and concerts, but should also be adapted to theatrical and cinematographic entertainments. As the details of planning these two latter types of building will be discussed in subsequent articles, there is no need to deal with them here. The main floor of the assembly hall is usually sprung for dancing while adjacent to the assembly hall there must be the necessary serveries and a fully equipped kitchen to provide for the occasion when the hall is used for a banquet. The assembly hall, besides being close to the mayoral suite, should have a separate entrance for the public and the usual exits in accordance with the regulations for the safety of the public in case of fire.

The Law Courts

The modern group of municipal buildings nearly always includes one or more law courts. There is no necessity for the law courts to be actually contiguous to the municipal offices or the assembly room (at Cardiff, for instance, the law courts are separated from the town hall by a public thoroughfare), but frequently they do in fact form component parts of a single great building. Municipal buildings may accommodate a police court, session court, assize court, and coroner's court. Of these, the assize court is the most important. A special architectural emphasis is here given to the judge's chair, which is raised on a dais, while provision is made for the various officers of the court—the judge's clerk, the sheriff, counsel and solicitors, jurors and witnesses. The members of the jury have their retiring room and separate lavatory accommodation. The dock, usually in the centre of the court, has within it a small staircase leading to the cells below the level of the floor of the court. Adjacent to the cells there are separate exercise yards for prisoners of either sex. Rooms are also needed for the use of prisoners on the occasions when they are allowed to consult with friends or counsel. In the planning of a law court attention must be paid to the convenient relative positions of the people principally concerned with the case, namely, the judge, the jury, the counsel, the witnesses, and, lastly, the prisoner. Adequate provision must also be made for the Press. It is essential that the planning of a law court should be as compact as possible, so that all the people concerned with the case may see and hear each other easily. These requirements also hold good for a police court. Here there is no necessity for a jury box, but the bench must be large enough to accommodate as many as about twenty magistrates. In association with the court there must be rooms for solicitors and barristers, robing rooms, offices for clerks, and a law library. Occasionally, the judge's private room has a luncheon room adjacent to it. Separate lavatory accommodation is provided for the various functionaries.

Circulation

In a group of municipal buildings an important element of good planning is the circulation between the various departments. The provision of well-lit corridors is essential. A convenient practice is to provide one or more interior courts which make possible the occasional side-lighting of the corridors and access from them to lavatories also lit from the interior court, which, at the same time, can be used for the assemblage of the various pipes and other connections necessary for drainage. Several public entrances should be provided. The principal entrance should lead to the ceremonial staircase, giving access to the council chamber, mayoral suite, and committee rooms. In some instances this principal entrance is reserved for councillors and other functionaries, but some architects hold that citizens having business with the rates office or other departments should be privileged to use this main entrance. There is much to be said for this latter arrangement, which certainly leads to ease of supervision by the porters. The principal entrance is often marked by an imposing flight of steps, which, however, must not be too numerous, as in the Portsmouth Town Hall, a very noble design in other respects. It is recorded that some years ago the late Madame Sarah Bernhardt was invited to a civic reception in this building. When she arrived at the broad base of a flight of fifty or more steps, she threw up her hands in despair and declined to proceed any farther.

Equipment

Needless to say, all the offices should be well lit, and to secure this the depth from the window wall to the partition should not be any greater than 20 ft. The proportion of window space to wallage should be normal, that is to say, the proportion which has been found suitable for the English climate. Over-lighting has its disadvantages just as much as under-lighting. General floor-to-floor heights should be from 10 to 12 ft., except in the committee rooms, where a greater height may be desirable. Main staircases should be not less than 6 ft. wide, while lifts should be available if there are more than two floors above the ground floor. The materials used in town halls for the construction of the floors, walls, and roof do not necessarily differ from those employed in other large buildings, while the provision made for the heating and lighting of the rooms do not present any special problems. The modern group of municipal offices is installed with the best obtainable equipment for lighting, heating, noise prevention, while the construction is of course in accordance with the most modern standards. Sound-absorbent materials, such as cork or rubber, should be used for floors. Ventilator fans, lift motors, and other machinery should be of the type which run most quietly. A central plant is generally used for air conditioning the large rooms, such as the council chamber and law courts, so that there may

be three to four changes of air per hour. Offices and other rooms are usually heated by the method of radiation. The heating system may be of the usual alternative types, electricity, gas, oil, coke, or coal. Low-pressure hot water for heating is the general practice. The boiler house should be of ample dimensions and well ventilated.

Choice of Site

An important consideration affecting the design of groups of municipal buildings is the choice of site, and this question is a very wide one which need only be discussed here in so far as it influences the actual disposition of the group. A civic centre can comprise a group of public buildings on island sites, such as in the well-known case of Cardiff. While this arrangement is effective in many ways and makes possible the expansion of the various units of the group, it would be unwise to suggest that it is the ideal arrangement which ought to be followed on every occasion. A town hall sometimes makes a bigger contribution to the architectural dignity of a city if, instead of being in splendid isolation, it takes its place in a principal street and presides over an assemblage of commercial and other buildings. In such a case it could perhaps have only one façade exposed to public view. Some of the town halls of the London Metropolitan boroughs are so situated, yet look very well in this street setting. A former practice which obtained in small country towns was for the town hall to be placed on an island site in the middle of the principal thoroughfare. Often the ground floor was an arcaded market-place, while above it was the council chamber and mayor's quarters. There still remain charming examples of this treatment, and with modification occasioned by the great increase in the accommodation required, such an arrangement could still on occasion be followed. On a large island site surrounded by streets a modern municipal group containing all the elements here described could be planned, and the façade on every side could be given a character expressive of the functions performed by the various parts of the building. The question of noise would in such case need to be carefully considered. Where central heating is employed and an adequate system of ventilation, there should be double windows facing the street, while a certain number of the rooms should be top-lit or face interior courts. There is much to be said for placing the municipal buildings in the business centre of the town, where the need for architectural dignity is strongest, rather than banish them to a more secluded spot. This, however, is a question which can be decided only after consideration of the geographical and other characteristics of each locality in which the new town hall is to be built.

THE DESIGN AND PLANNING OF FACTORIES

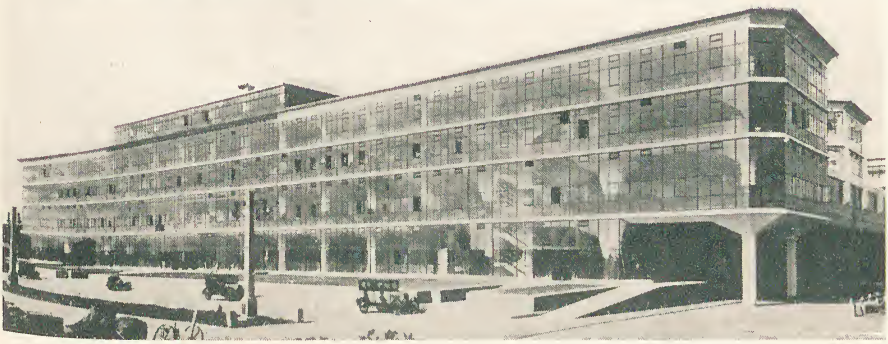


Fig. 1.—A MODERN EXAMPLE OF THE MULTI-STOREY TYPE OF FACTORY
Messrs. Boots' factory at Beeston, Notts.

FACTORY practice, in design and construction, has advanced to such a degree of efficiency that many factories in this country and abroad have become dated in a little over five years.

The influences behind this rapid advance are principally :—

(1) General trend towards improved working conditions.

(2) The broader outlook of directors of industry.

(3) The mushroom growth of new industries, and the improvement of trade generally.

Under these influences the factory architect has immense scope, unhampered by tradition, yet controlled by the dictates of efficiency, economy, fitness for purpose, and good taste.

Factory Architect's Training

Tradition in factory building plays a very small part in the planning of a factory ; the design is subject to the approval of the hard and shrewd business man, the modern industrialist, who will demand a combination of rapid work, quick and accurate decision and advice. This job has very little tradition, culture, or custom, and there is every reason why the basic principles of design should be truly modern.

The Plan

The process to be housed must be understood, and planned on unit principles, repetition of units to facilitate mass production, and the

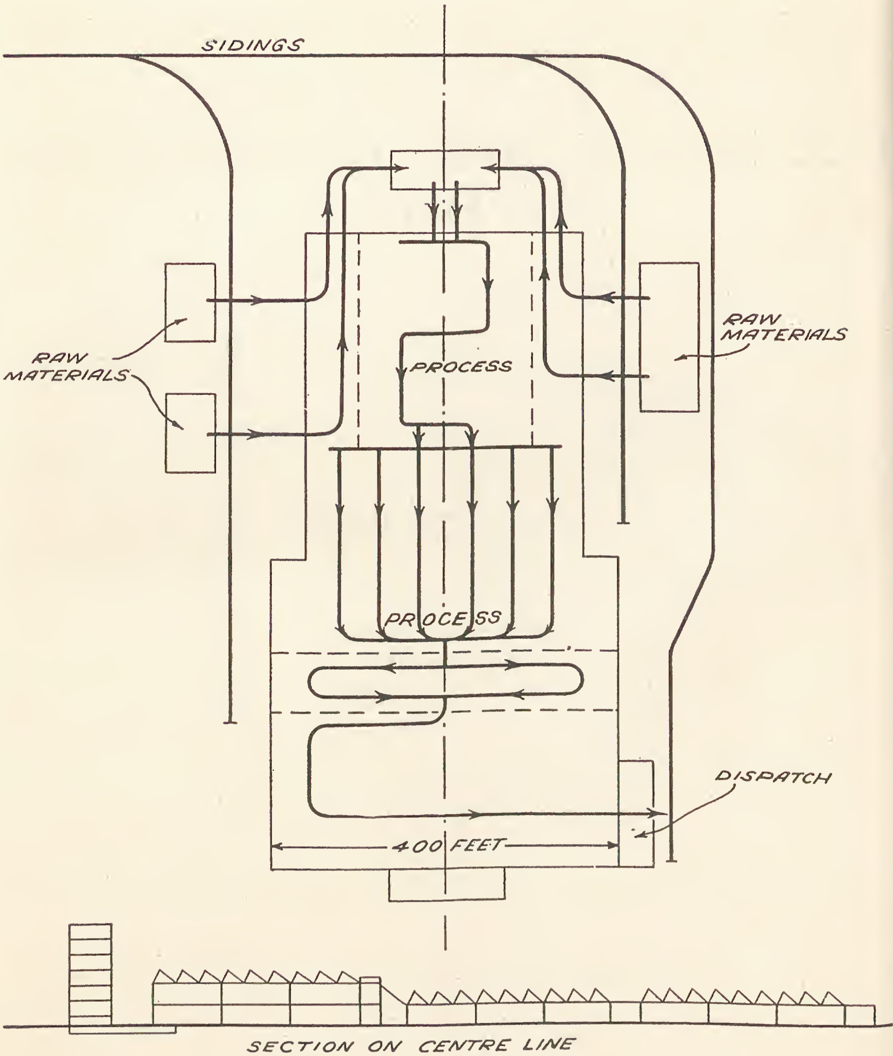


Fig. 2.—UNIT DESIGN IN FACTORY PLANNING

This example shows an economical and logical flow of process, from raw materials, with their various treatments, through the several departments in the main building, and finally to sorting, packing, and dispatch. Note the neat assembly of multi- and single-storey buildings as the process demands.

essential adjuncts of the smooth and efficient running of mass production. The training of the architect is such, however, as to make him peculiarly fitted to deal with the design of these structures, which are essentially problems in planning.

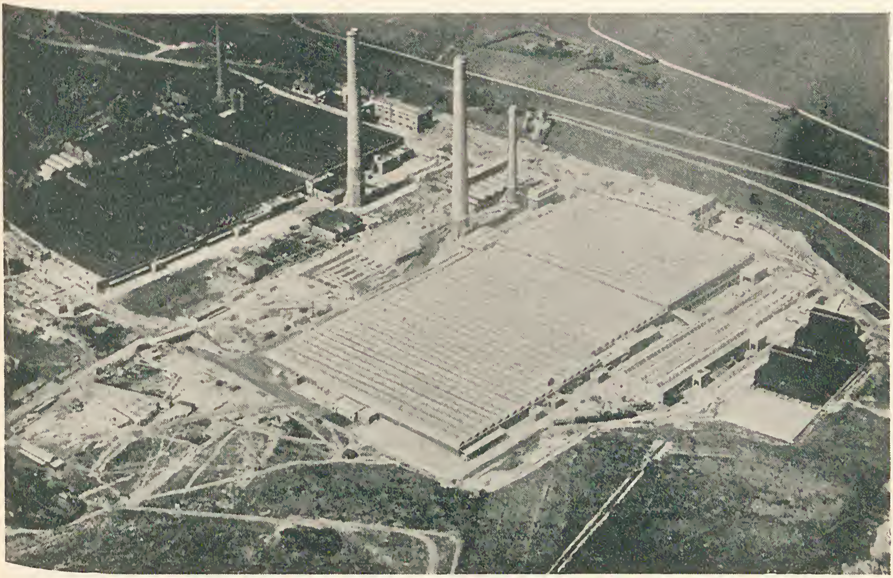


Fig. 3.—AERIAL VIEW OF A COMPLETE TEXTILE FACTORY

This comprises two units duplicated about the centre line between the two tall chimneys. The roof of each unit, in both the single- and double-storey portions, is of the north-light saw-tooth type. North and south runs from top right-hand corner to bottom left-hand corner, the photographs showing the board-and-felt side of the roof. Each unit is 740 ft. long by 420 ft. wide.

The gutters between the north lights are constructed of 2-in. grooved and tongued boards, surfaced with asphalt on expanded metal. The gutters are level from end to end, and 400 ft. long. All ends are joined up by a 3-ft.-wide flat running from north to south, and the R.W. pipes are spaced at frequent intervals on east and west walls. For circulation of process in one of these units, see Fig. 2.

The unit principles of design should be based on a provisional decision of column centres if this appears appropriate, or alternatively a unit of production which the factory is to house. In the single-storey plan the basis of planning would be the unit adopted. Works managers generally call for open areas of floor space without obstruction, and as roof supports have to be allowed somewhere, the unit of area must be conceived at a very early stage. This will dictate the types of buildings, which will be (1) single storey, (2) multi-storey, and (3) a combination of these two.

Generally speaking (1) is mainly suitable for industries handling large and heavy components and heavy plant, and where the output consists of a comparatively small number of large articles ; (2) is suitable to industries where the process comprises the manufacture and assembly of a large number of small finished articles passing through multiple processes from limited raw material to highly processed finished articles ; and (3) large storage of components or raw materials involving many and varied stages of manufacture with small finished products. The large-

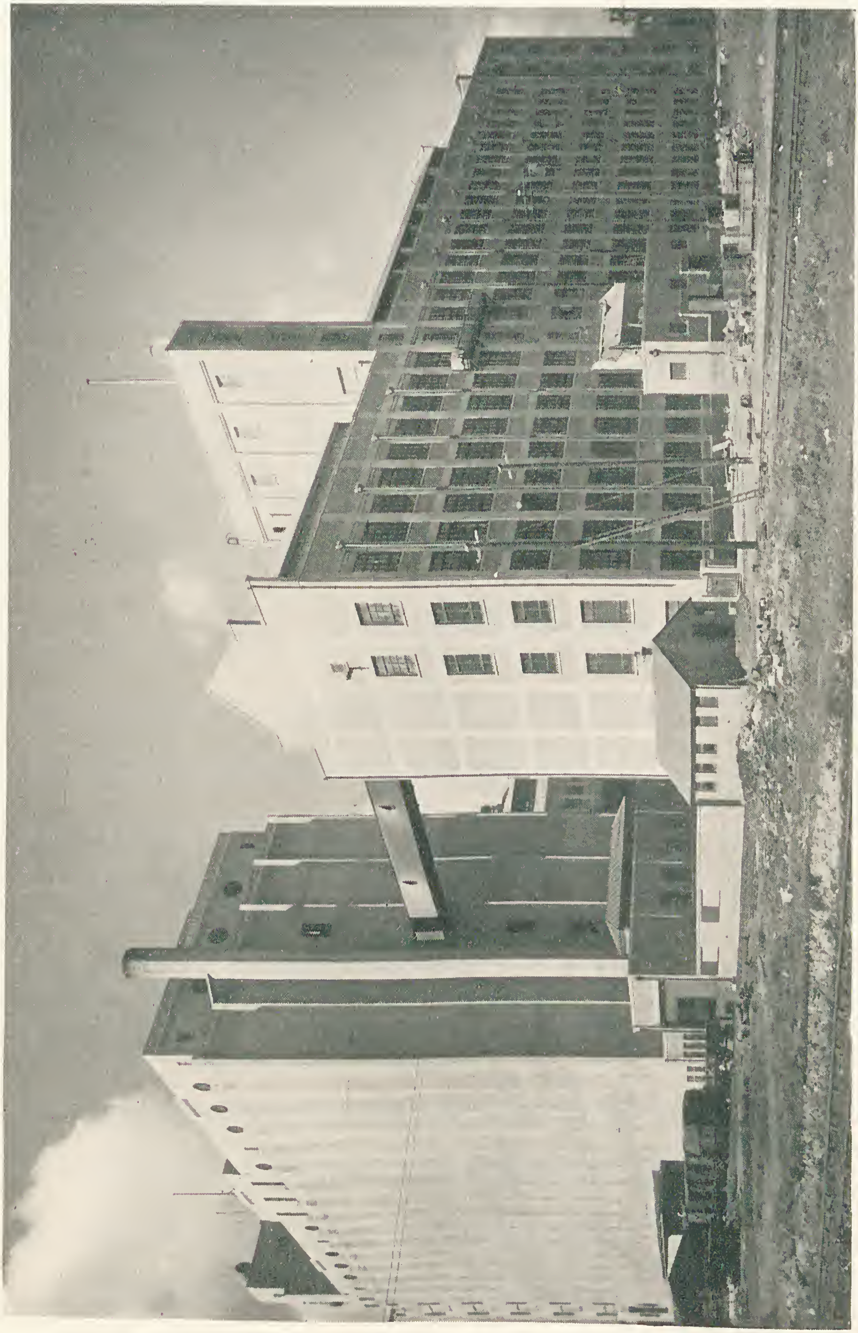


Fig. 4.—MESSRS. SPILLERS' FACTORY AT CARDIFF, DESIGNED BY JOHN CLARKE & SON

A description of this factory is given on the facing page.

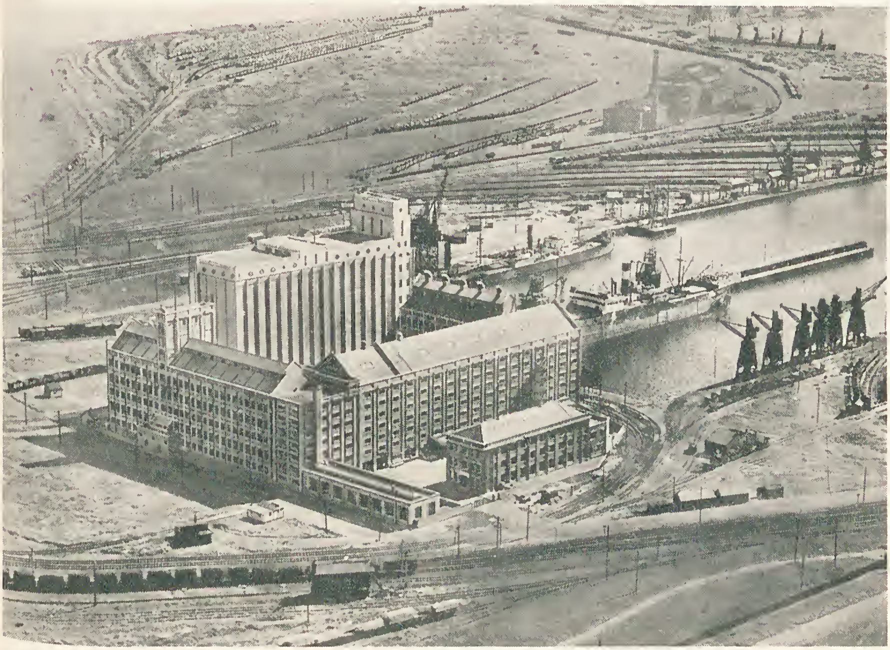


Fig. 5.—LAYOUT OF THE NEW MILLS, WAREHOUSE, ETC., ROATH DOCK, CARDIFF, FOR MESSRS. SPILLERS LTD.

The main buildings comprise flour mills, provender mill, warehouse, silo, Victoria foods factory, workshop, garage, offices, etc.

They are erected on concrete-pile foundations, which were driven to an approximate depth of 40 ft., the heads of the piles being capped and carrying a reinforced-concrete raft floor. The silos are also of reinforced concrete.

The sizes are roughly as follows :—

Provender mill	123 ft. long,	55 ft. 6 in. wide,	103 ft. high
Flour mill	222 ft. ,,	56 ft. ,,	93 ft. ,,
Warehouse	284 ft. ,,	67 ft. ,,	100 ft. ,,
Victoria foods	168 ft. ,,	65 ft. ,,	77 ft. ,,
Workshop	70 ft. ,,	28 ft. ,,	32 ft. ,,
Garage	123 ft. ,,	33 ft. ,,	30 ft. ,,
Offices	166 ft. ,,	44 ft. ,,	58 ft. ,,

The buildings are of the steel-frame type, the wall stanchions and beams being encased in concrete which is also reinforced with rods to obviate cracking. The internal stanchions and beams are not encased. The walls are of Beaufort brick and are of the cavity type, the two thicknesses being tied together with stainless-steel wall ties, and the large panels are also reinforced with " Exmet." The mortar is cement and sand.

One of the buildings in this group was built of reinforced concrete of special design.

The mill floors are Archangel yellow deals, laid on the flat and covered with Canadian maple. The warehouse floors are of 4-in. by $2\frac{1}{2}$-in. Columbian pine, laid solid 4 in. thick and covered with similar maple.

The roofs are diagonal boarded and then covered with felting, cross-battened, and slated with Velinheli slates.

scale factory more often falls to this group for reasons of the segregation of processes and economy of distances between departments.

Fig. 6.—EXAMPLE OF FACTORY BUILDING IN COURSE OF ERECTION, WITH NORTH-LIGHT TYPE OF ROOF TRUSS

The centres of main trusses are 52 ft. span and 25 ft. in the direction of steel columns shown. The type of truss used is better illustrated in Fig. 7. The absence of purlins is very noticeable in these illustrations. The boarded side of the north-light truss was constructed in 2-in. grooved and tongued boards fixed direct on to blades of each truss by a 2-in. ground, asphalt gutters being formed on the same type of boarding, and the south slopes finished in felt.

With regard to the multi-storey buildings, the remarks relating to unit design and circulation in single-storey design apply here too. The unit in the multi-storey is of necessity smaller, or at least more restricted, as the construction affords less latitude in unit size. Clearances and lighting efficiency have to be economically worked out, and are, of course, governed in the first place by the type of work to be undertaken.

Site

The choice of site is of paramount importance, as the decision will influence everything. In some cases the architect is not called in until after the client has acquired a site. This, in many cases, is a dangerous procedure. The architect should always be consulted on the question of choice of site, and the reasons for this are :—

(1) That only the architect is able to visualise the scheme from the

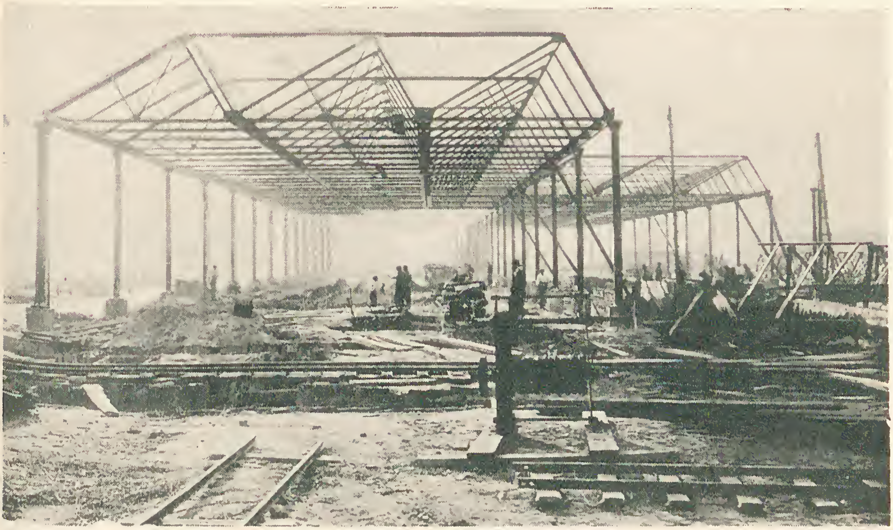


Fig. 7.—SINGLE-STOREY FACTORY SHEDDING IN COURSE OF ERECTION

The top horizontal member of the truss remains outside the building in the completed roof. The long slope to left is boarded and felted, and the short slope to right is continuous patent glazing.

The large R.S. joists running in the bays between main trusses support the two intermediate simple trusses between the main trusses. The top member of the truss, therefore, is outside the building when the roof covering is completed.

As the stresses are simple in the supports, the columns may be of cast iron rather than steel on a point of economy.

aspect of a building in progress, with its many problems of drainage, foundations, levels, approaches, etc.

(2) That the architect is the better able to judge, from his knowledge of the factory's requirements, the most suitable site features to look for.

An example of these points is explained when one compares the percentage costs of foundations, drains, roads, paths, and approaches with those of the carcass and finishings of the completed buildings. In straightforward single-storey north-light sheds or shops with outer walls in brick and moderate floor loadings, the cost of foundation work, up to under side of ground floor, will vary between 10 and 33 per cent. of the contract cost. This large variation in relative cost can generally be attributed to good or bad siting. A suspended floor always costs more than a ground slab given equivalent loadings, and a ground slab cannot safely be laid without properly prepared and even-bearing ground.

The Multi-storey Factory

The question often arises as to which is the more economical building: the multi-storey occupying a small site area or the single-storey of light construction on a much larger site. This is best answered by analysing the merits and demerits of the salient points.

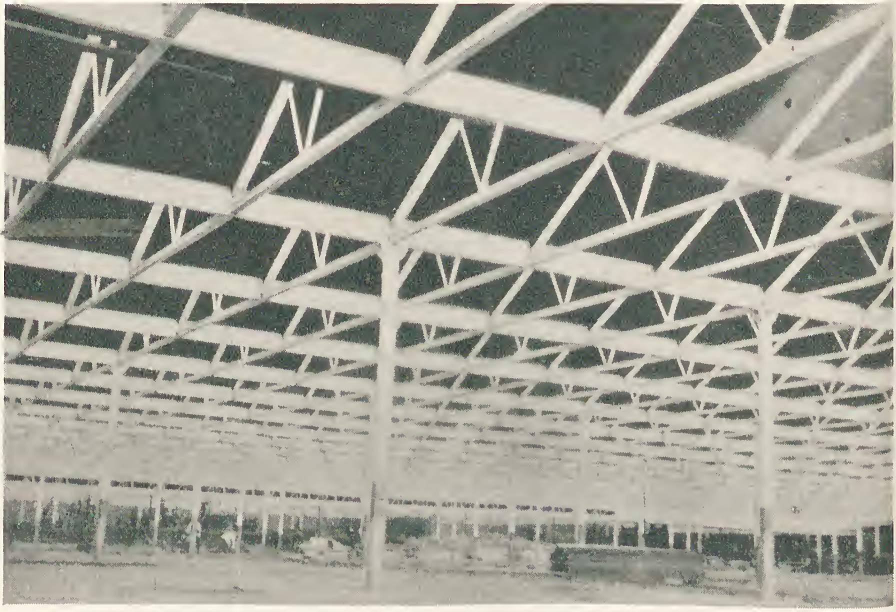


Fig. 8.—THE SINGLE-STOREY SHED ILLUSTRATED IN FIGS. 6 AND 7, SEEN ON COMPLETION

Note the clean lines and open floor area. A feature of this type of shedding is the small proportion of "dead area" between tie and truss to roof covering, compared with uninterrupted working area. This is an important feature when considering natural light and the expense of artificial heating of the building.

Multi-storey buildings are advantageous :—

(1) When site values are high on the basis of area to be built over.

(2) When components are small, easily conveyed from one department to another in the process of manufacture.

(3) When gravity feed from floor to floor (as is the case where the product is fluid), may be used to advantage in the manufacturing process.

(4) Where air conditioning is necessary in a number of departments, or where seasonable variations in temperature or weather adversely affect process.

(5) When the work to be carried on is mainly sedentary.

(6) When bearing value of ground is low and suspended construction is necessary at ground level.

The Single-storey Factory

Single-storey buildings are :

(1) More rapid in construction, giving earlier occupation or partial occupation.

(2) Capable of better natural and general lighting at an equivalent cost,

(3) Generally cheaper on the basis of floor area owing to the lighter construction and larger centres of supports.

Walls, Floors, and Roofs

If a unit design is adopted in factory practice, the structural parts are invariably reinforced concrete or structural steel frame. In this case, external walls can be considered as filling-panels, carrying no structural or process loads, and internal walls merely as partitions. Under some local authorities this view of construction cannot be read into the by-laws, length and height of walls being the determining factors on thicknesses; and it is often very difficult, and in some cases impossible, to get plans passed without strict observance of the by-laws, which were originally framed to cover walls that serve as structural parts of a building.

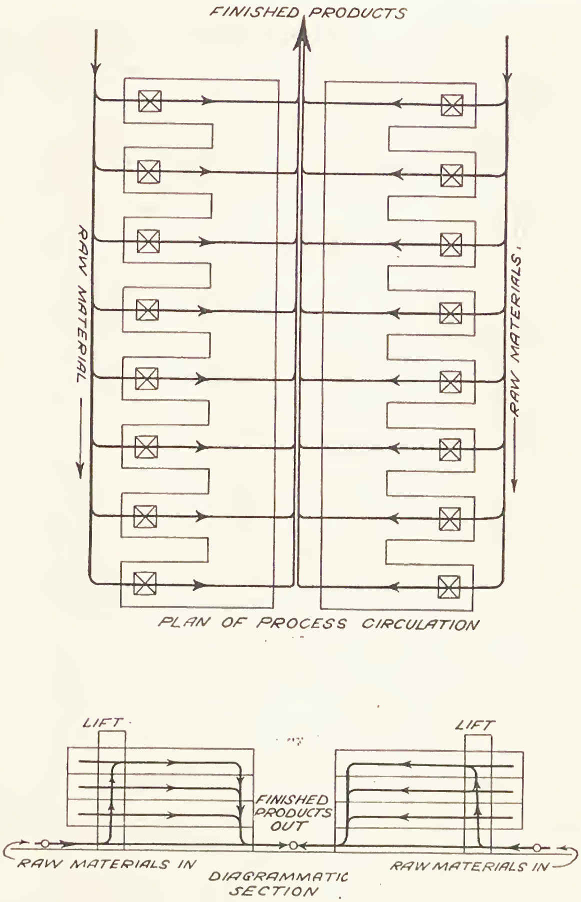


Fig. 9.—UNIT DESIGN IN FACTORY PLANNING, ILLUSTRATING A COMPLETELY DIFFERENT TREATMENT

This multi-storey building is planned to house processes involving a large number of raw materials passing through entirely separate channels of manufacture, the completed articles being many and varied. The raw materials are hoisted to the top of the building and descend through their several processes to the finished article, leaving the building at the centre. (See also Fig. 1.)

Ground floors taking a direct and distributed bearing on the ground are best built in concrete on a hardcore bed. Light steel-fabric reinforcement laid in a 6-in. to 9-in. coarse aggregate concrete bed is a cheaper construction than a ground floor of rod reinforcement of much less thickness of concrete. Suspended floors should be designed in hollow or cellular constructions for the purpose of sound and heat insulation and lightness.

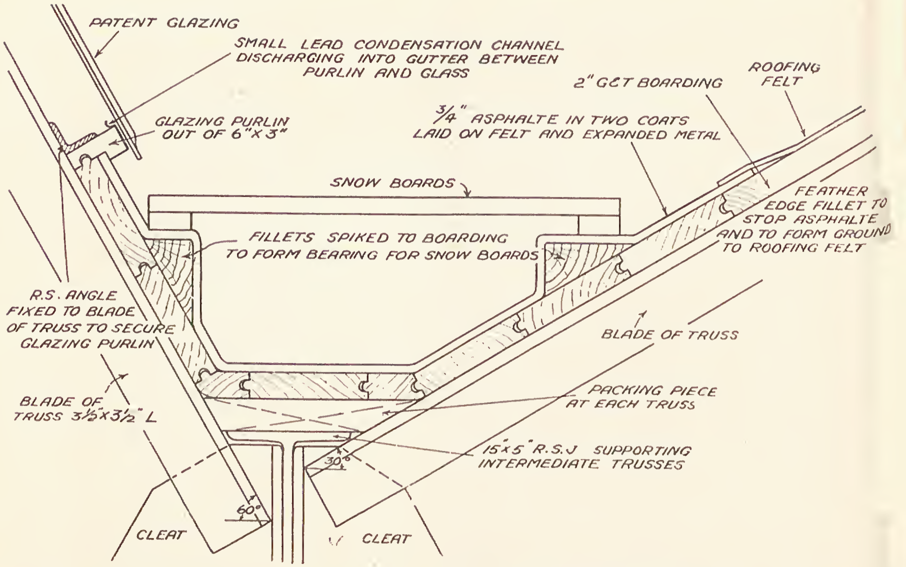


Fig. 10.—A TYPE OF GUTTER FOR NORTH-LIGHT CONSTRUCTION WHICH IS VERY EFFICIENT IN PRACTICE

Long runs of anything up to 500 ft. may be safely constructed without either falls or intermediate outlets, providing the full cross-section at each end is available for discharge. The junction of felt roof to asphalt is made with a feather-edge fillet spiked to boarding, and the felt is fixed with a mastic which will adhere both to the asphalt and to wood. The felt is also close nailed with large round-headed and galvanised nails, which are finally given a coat of mastic applied by brush.

The small lead condensation channel, fixed by the patent glazing fixer, discharges at close intervals over the glazing purlin. The small space between glass and purlin is provided by the thickness of the tie in the glazing bar.

A 6-in. reinforced-concrete suspended slab incorporating hollow or cellular blocks is of almost equivalent cost to that of solid reinforced concrete.

The advantages of the former in insulation and lightness are obvious, and there is less likelihood of temperature cracks forming. The saving of weight by using a cellular or hollow floor construction is agreeably reflected in the dead loads to be carried on the structural frame.

Roofs

There is an almost endless variety of products which factory premises have to house, each and all requiring some feature of design different from another. This affects to a large extent the roof design.

In a single-storey type of factory almost the whole of the natural light and ventilation is to be from this source, the most usual type being the north-light saw-tooth design, the ratio of light-area to floor-area being high, and distribution of light is general.

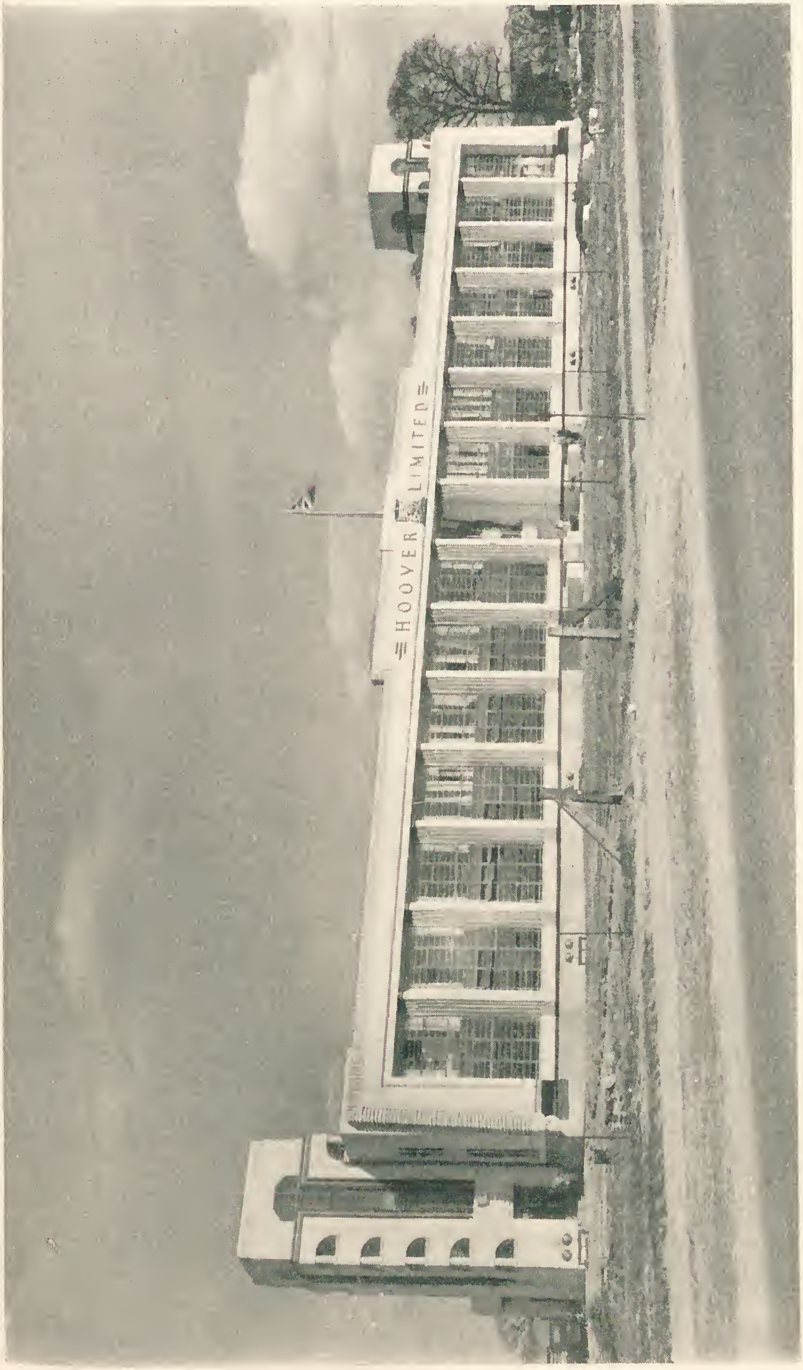


Fig. 11.—A MODERN EXAMPLE OF FACTORY DESIGN
(*Architects: Wallis Gilbert and Partners, FF.R.I.B.A.*)

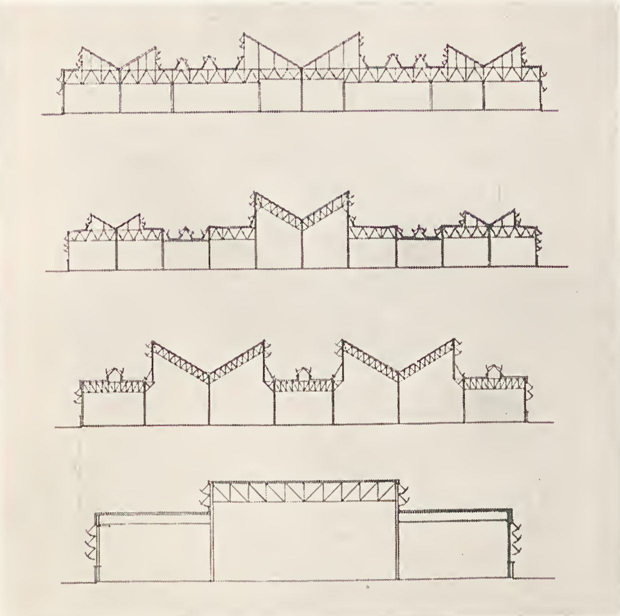


Fig. 12.—Four examples of advanced type of factory construction

The main features are more efficient lighting and ventilation, and layer spans for machinery.

Ventilation can be moderately efficient without mechanical acceleration, but never all that can be desired. It is a Victorian fallacy that north light is the best light for general working conditions, such as prevail in an orthodox factory.

The North-light Saw-tooth Roof

The north- light saw-tooth roof is a very economical roof type, and it is not advocated that the glazing side should face any other direction than toward the north.

The " Butterfly Roof "

A far better light is obtained by adopting the type generally known as the " Butterfly Roof." This has been developed in several ways, but all to the main end of combining adequate natural ventilation with good general lighting distribution. In the " Butterfly Roof " glazing is, as far as possible, vertical, and in all cases arranged to admit east and west lighting. This type demands a larger proportion of dead area over the roof clearance than does the north light, resulting in a larger volume of air to heat in winter. One of its advantages is that the design admits the early morning sun, which cleans, warms, and freshens the air inside before work commences, and admits the evening sun to the same ends.

Considerations such as these are a decided advantage, and a stimulus to greater efficiency on the part of the workpeople.

Heating and Ventilation

The fact that the heating of factories is not governed by hard and fast rules, or decided by falling in with general practice, is no reason for overlooking its consideration in the early stages of planning.

If steam is to be used in the process work, low-pressure and waste

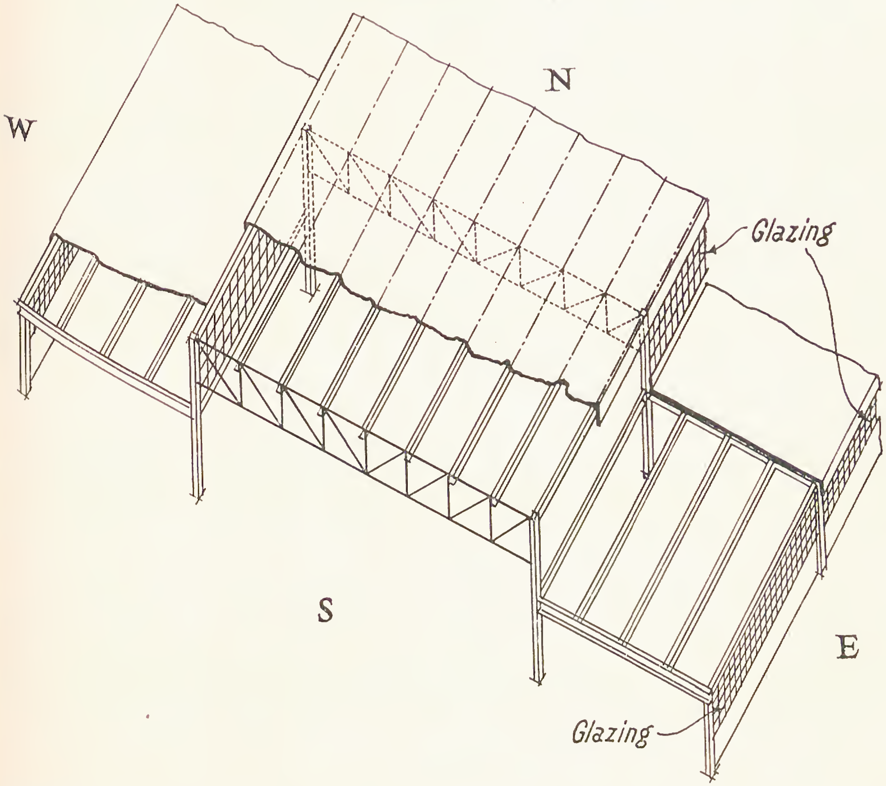


Fig. 13.—Enlarged detail of roof construction for advanced type of factory shown at the bottom of fig. 12. This shows the orientation

steam can often be used economically for heating. Conversely, the question as to whether steam power is necessary in process work is often influenced by the adoption of steam for heating the building itself, and in some cases the question of steam heating, in whatever form adopted, has caused the company to lay out a steam plant for generating a portion of their electrical energy. The heating of a department involving work of a heavy nature with considerable physical effort, would prove totally inadequate for a building where work of a sedentary nature is carried on. In some factories air conditioning is necessary in certain departments, and here the heating and ventilation plants are incorporated to a large extent. The fact that air conditioning, either humidification or de-humidification, is to be installed, makes it necessary to consider this issue in the very early stages of design. Roof design will be affected and ventilation will be mechanical and controlled.

Here is an example where the carefully considered design of a certain department in a factory failed to come up to expectations. The

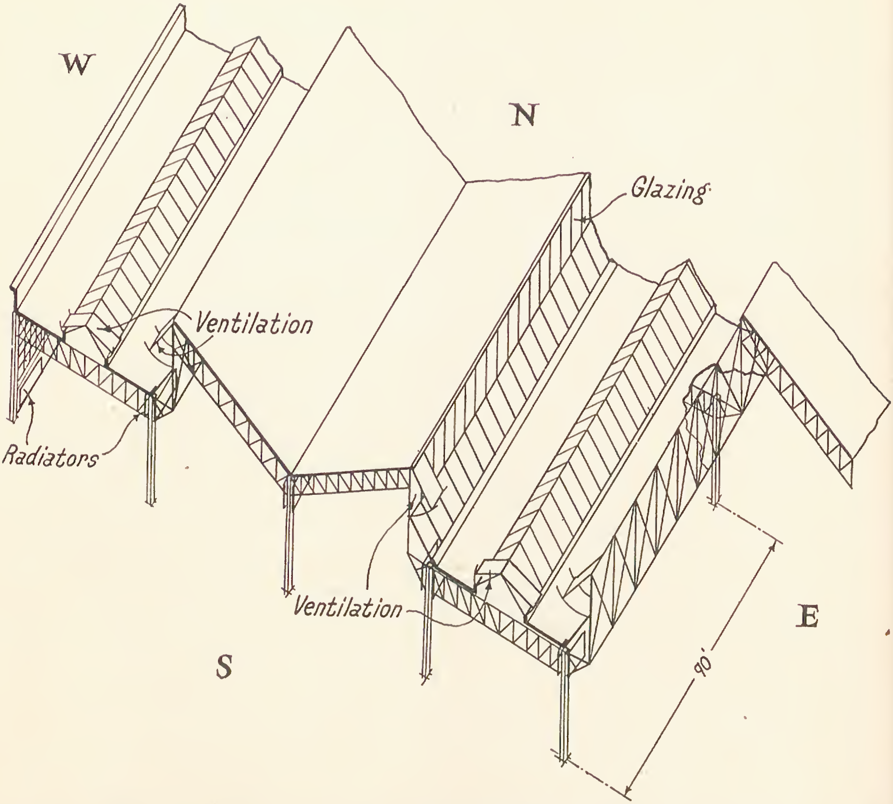


Fig. 14.—Enlarged detail of roof construction for factory shown in the third diagram of fig. 12. Showing the orientation and also ventilating arrangements

process required adequate natural light, and the air within the department was conditioned. Throughout the year the temperature was maintained at 70° F., with a dry bulb constantly at 80 per cent. relative humidity. The department was roofed on the north-light principle, and the glass runs were continuous, some 400 ft. in length. In February of 1929 there was a whole month's continuous frost, and with an average temperature several degrees below freezing-point outside the glazing, and a conditioned air of 70° F. and 80 per cent. humidity inside, there was, of course, a very heavy condensation on the glass. This condensation was adequately dealt with for a time by the condensation channels fixed on the glazing purlins, but as the frost continued the condensate was accumulated in the form of ice in the gutters and at the lower end of the glass, eventually sealing completely the outlets, with the result that the condensate dripped continuously inside the building. One may see examples of the elaborate and expensive provisions

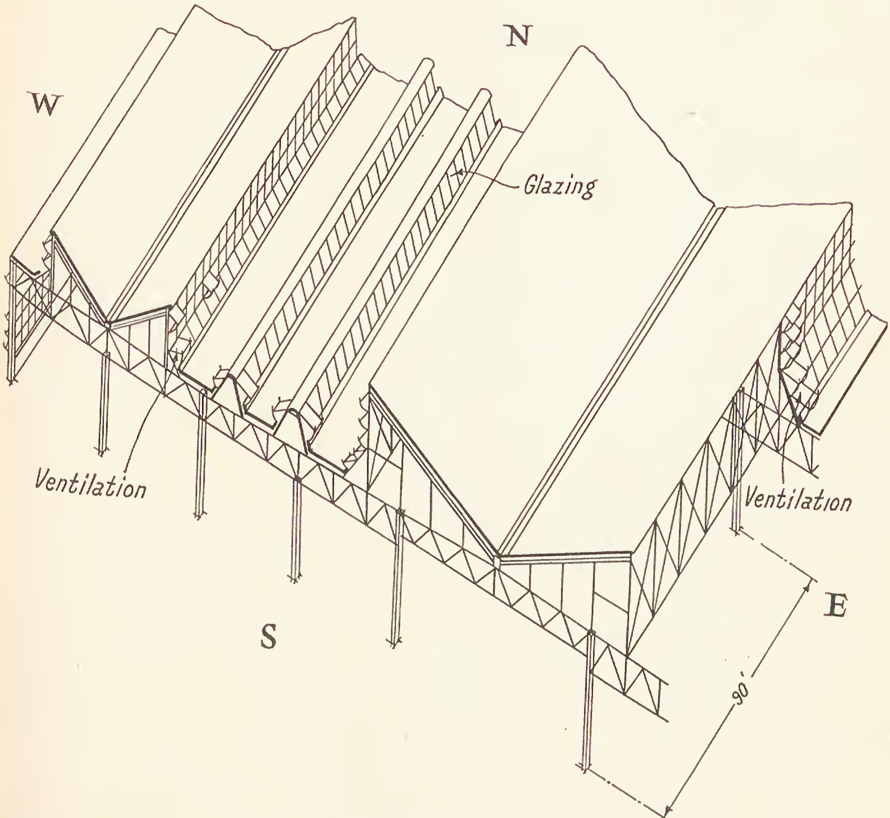


Fig. 15.—ENLARGED DETAIL OF ROOF CONSTRUCTION FOR FACTORY SHOWN AT THE TOP OF FIG. 12. NOTE THE ORIENTATION AND SPECIAL PROVISIONS FOR ROOF VENTILATION

made in American and Canadian factories to deal with condensation under winter conditions there, but the problem very much less frequently arises in this country, and can generally be accommodated without an internal piping system.

As a general rule the most efficient type of heating for factories is a series of unit heaters fixed in the roof—these unit heaters to be designed to give a moderate temperature to the air at such times as the building is unoccupied, while at other times the heating is accelerated by mechanically operated fans blowing through the units.

Floor Finishings

As the majority of factory floors are of concrete structurally in one form or another, it is very usual to use one of the many proprietary or other forms of floor finishes. The works manager usually assumes that concrete floors are cold. Whether in suspended or ground floors, concrete

only looks cold, and is therefore assumed to be cold by the worker. If the grano finish could be disguised in some way by permanent colouring or other method, the worker would lose his prejudices against it. On the other hand, repairs are difficult to carry out, and concrete emphasises noise within the building. The most suitable finish for the average factory floor where the work is of a not too heavy nature, is maple boards, laid in mastic on a bed floor of grooved-and-tongued deals. If the maple is cramped up, grooved and tongued at ends only, and fixed down by nailing from the top surface with cheese-headed nails countersunk, then one has a good wearing surface and a good finish for most purposes. Repairs are easily carried out in the places subject to exceptional wear, drawing the nails and cutting out the worn boards without disturbing the main floor.

Costing

One of the first questions a factory architect is asked after he has once been approached and has produced a scheme is, "What is the cost of your scheme complete?" A reliable method of computing costs is therefore necessary. One may start with a basis of 6*d*. to 9*d*. per cubic foot, adding lump sums for such items as foundations, special floors, show-rooms, roads, paths and approaches, drainage, and services such as heating, lighting, etc.

A useful method of computing cost for presenting to the client is that based on a unit of factory process. For example, a factory for some textile product may be priced on the basis of so much "per spindle" if the number of spindles to be installed is known. A basis of feet super or "bay" is often a more appropriate unit if the factory process includes several distinct and different finished articles.

Modern Forms of Roof Construction

Figs. 12, 13, 14, and 15 illustrate a more advanced type of factory construction. Briefly, the main features are more efficient lighting and ventilation; larger spans and greater clearances for large machines and the working of either jib cranes or overhead travelling cranes within the building. Lighting is more efficient in view of the fact that the glazing admits the east and west sun. On a sunny day the sun's rays will be admitted to the building at the early and late hours. This has proved to have a favourable effect on working conditions and to result in a definite improvement in the workers' output. Ventilation is efficient without causing draughts, and is simply controlled.

The most suitable heating for this type of construction is the unit heater, usually placed either in the roof space or immediately below.

FLATS AND COMMUNAL DWELLINGS

SECTION II.—ENTRANCES AND INTERIORS, TENEMENT FLATS

IN a previous section we have dealt with sites for flats, and the arrangements for lifts and staircases.

Whatever the type of scheme, however, in so far as the flats are concerned one problem is the same—namely, that of providing suitable and adequate entrances. A good approach or entrance is essential to flat-planning, and whilst as much space as possible must be conserved for letting as shops, at the same time economy must not be pushed to the extreme of ruining the approach to the flats. Fig. 2 illustrates diagrammatically various arrangements of approach in a typical suburban type of scheme.

The Flat Unit

Considerations of aspect must not in general be allowed to overshadow other cardinal principles of planning such as entrance or approach. Site restrictions invariably encountered, except in the case of suburban and more or less open sites, inevitably dictate which principles of planning may be exploited to the full and those which cannot receive the consideration they would on an open and unrestricted site.

Room Orientation in Flats

The correct orientation of individual rooms in a flat is rarely possible throughout a scheme. The ideal must be kept in mind and an effort made to approximate to the ideal as far as possible. Preference should, of course, always be given to living-rooms, particularly in the case of family flats. The living-room in a bachelor or *pied à terre* type of flat is not quite so important in so far as it is lived in for a comparatively short part of the day, though, of course, this does not imply that the unmarried are not equally entitled to a reasonable amount of sun and air. If possible, bedrooms should not face busy thoroughfares (Figs. 3 and 4).

An effort should be made to group all services, thus facilitating a concentration of drainage and plumbing, which are relatively expensive items. In London it is now permissible to plan internal bathrooms and

Fig. 1.—THE ENTRANCE TO SPENCER PARK COURT. (*Architect : H. Guy Holt, F.R.I.B.A., M.I.Str.E.*)

This is a modern block of flats, four storeys in height, comprising eighteen flats, having entrance hall, lounge, kitchen, bathroom and w.c., and two bedrooms as a minimum. All rooms are exceptionally well lighted, and the sun enters all rooms at some time or other of the day.

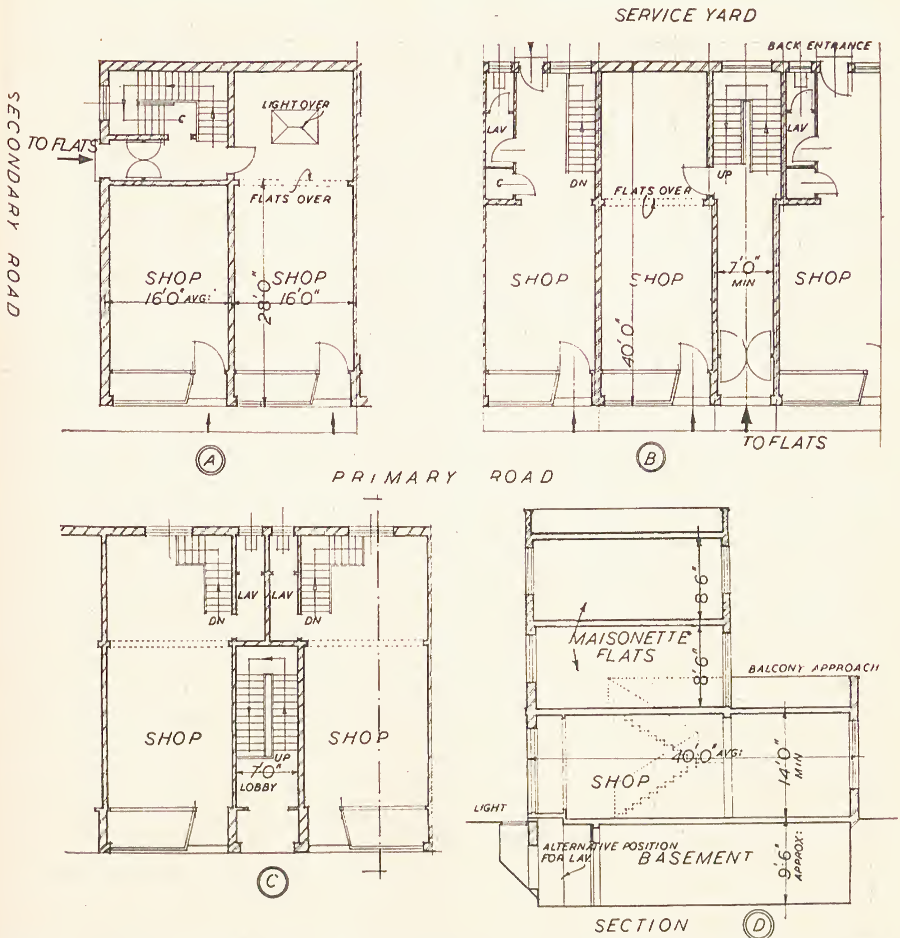


Fig. 2.—SHOWING SPACING OF SHOPS, ENTRANCES, ETC., IN A TYPICAL SUBURBAN TYPE OF DEVELOPMENT

kitchens, the services to such rooms being housed in internal ducts. Internal rooms, however, are singularly depressing, and whilst suitable, perhaps, for the hotel are not appreciated by the majority in the case of the flat.

Living-rooms

These should be placed near to the entrance to the flat, but should not become corridors or the means of approach. This will frequently be found the case in low-rental and tenement types of flat ; such an arrangement, however, is unhealthy, and the room is most uncomfortable to live in. Living-rooms should be made as large as possible. The tendency

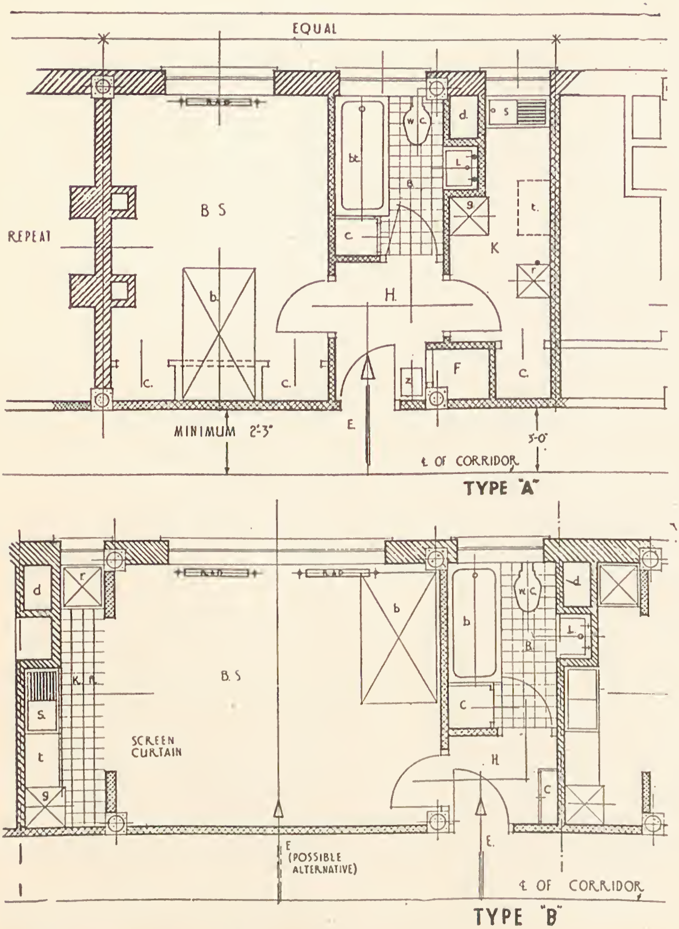


Fig. 3A.—PLANNING OF VARIOUS TYPES OF SINGLE-ROOM OR BED-SITTING-ROOM FLATS

These are planned on the central-corridor principle.

over the last few years has been to reduce the sizes of rooms to a ridiculous extent, leading in turn to a vast amount of rubbish being talked on so-called labour saving. There is a definite minimum beyond which it is undesirable to go even in the interests of the fetish economy. Economy which produces cramped living-quarters, which in turn cramp mind and spirit, is false economy. A living-room, for example, should not be less than 16 ft. by 12 ft. It is not desirable to have to pass bedrooms and bathroom to reach the living-room.

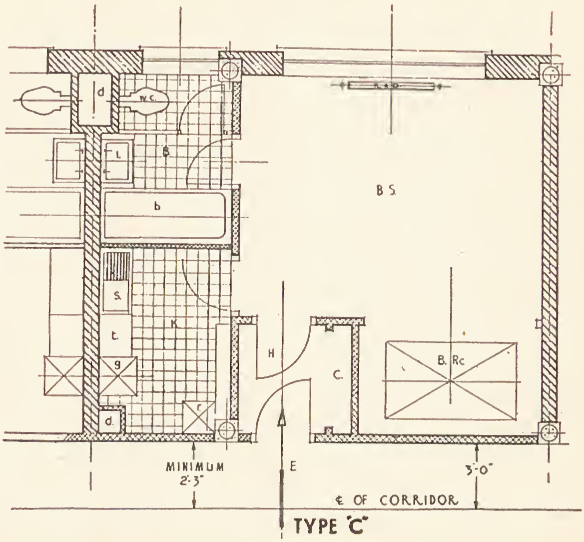
Bedrooms and Bathrooms

Bedroom and bathroom accommodation should form a separate and distinct unit, preferably cut off from living-rooms. This is particularly important in the higher-rental type of flat in which much entertaining may be anticipated. Bedrooms and bathrooms should not be entered from living-rooms.

Kitchens

Kitchen arrangements are frequently poor in flats. There has in the past been prevalent an idea that cooking is not necessary in a flat.

Whilst this may be true of a certain type of bed-sitting-room or bachelor flat, it is the exception rather than the rule. A kitchen which is 4 ft. 6 in. square, however well equipped, is useless as far as cooking is concerned unless the boiling of an egg or making of toast be accepted as the definition of cooking. The minimum kitchen size should be 10 ft. by 6 ft. Service from kitchen to living- or dining-room should be convenient, and in the higher-rental types an intervening pantry is desirable. The service stairs should deliver to the back door off the kitchen.



Entrance Halls

The entrance hall to a flat may be anything from a small lobby to a large lounge hall. In some cases of low-rental flats there is no room for even a lobby, and the flat entrance door opens right into the living-room. This is, however, very undesirable. Accommodation should be provided for hats and coats in the lobby, whilst in a more spacious flat a separate cloak room and lavatory may be planned off the hall. If large enough the hall is sometimes used for dining purposes to avoid cooking smells in the living-room. Should this be the case natural light and ventilation are desirable. It should always be remembered that a

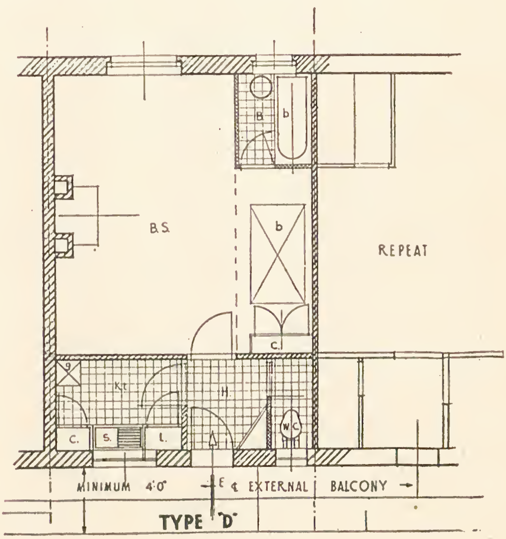


Fig. 3B.—Planning of various types of single-room or bed-sitting-room flats

Note the absence of separate service entrances.

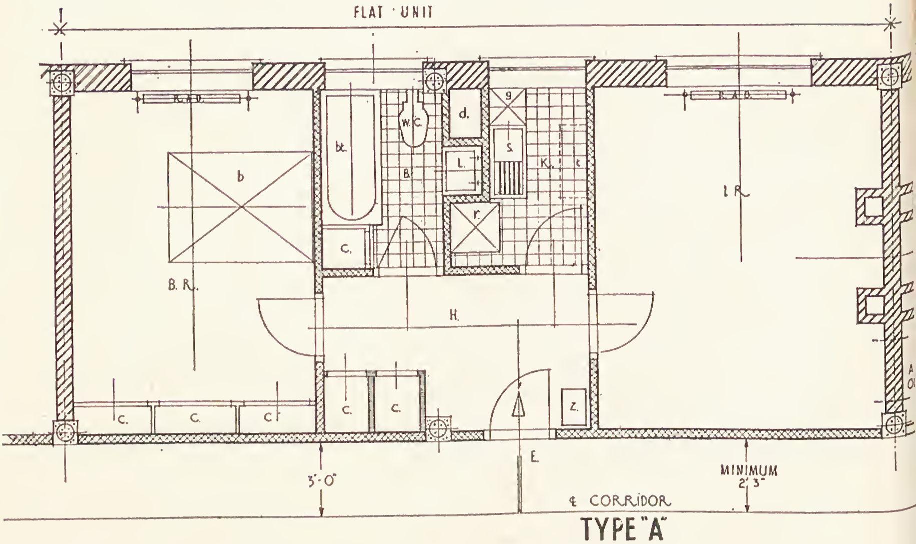


Fig. 4A.—Planning for small two-room flats
With hall, kitchen, and bathroom in the centre.

large number of doors renders any room draughty and uncomfortable to sit in.

Fig. 5 illustrates a plan of a high-rental type of flat, which does embody most of the principles of good planning. The plan is based on the group-

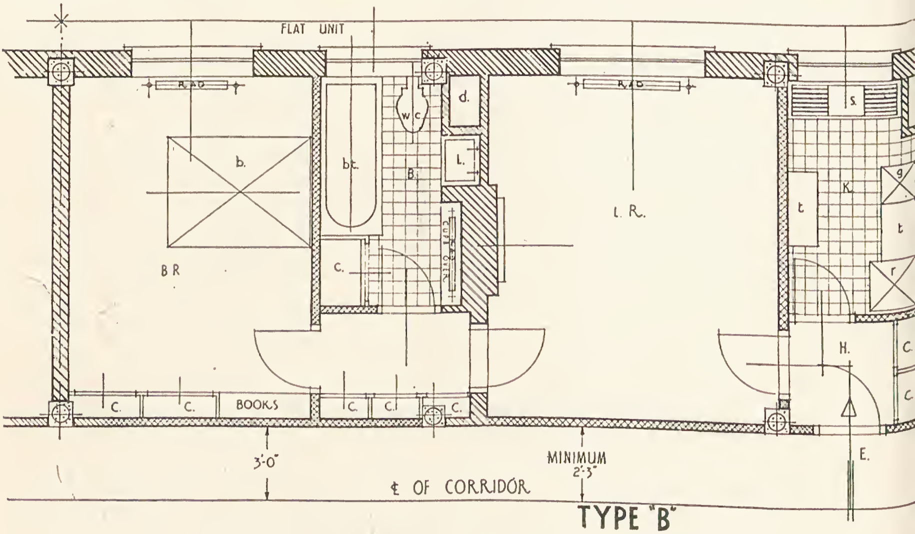


Fig. 4B.—Planning for small two-room flats
With hall and kitchen at one side and bathroom in centre.

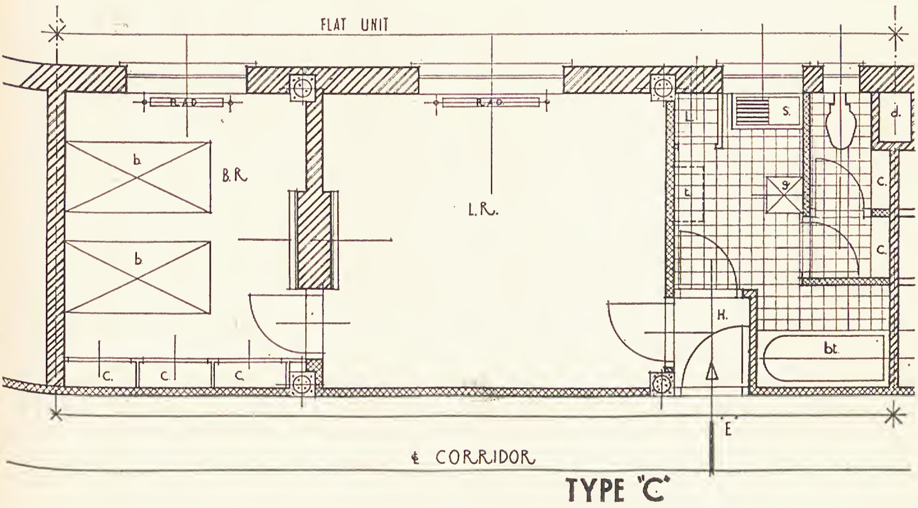


Fig. 4c.—PLANNING FOR SMALL TWO-ROOM FLATS
With hall, kitchen, and bathroom at one side.

planning system, i.e. the main entrance is from a short stair corridor which serves two or three flats per floor, and each flat has its own service entrance. The following points should be noted :—

(1) Separate service entrance and provision for refuse, which can be cleared without annoyance to tenants. Good light and ventilation to service stair.

(2) Grouping of reception rooms round the entrance hall.

(3) Cloaks and lavatory off the vestibule.

(4) Lounge hall and dining-room planned *en suite*.

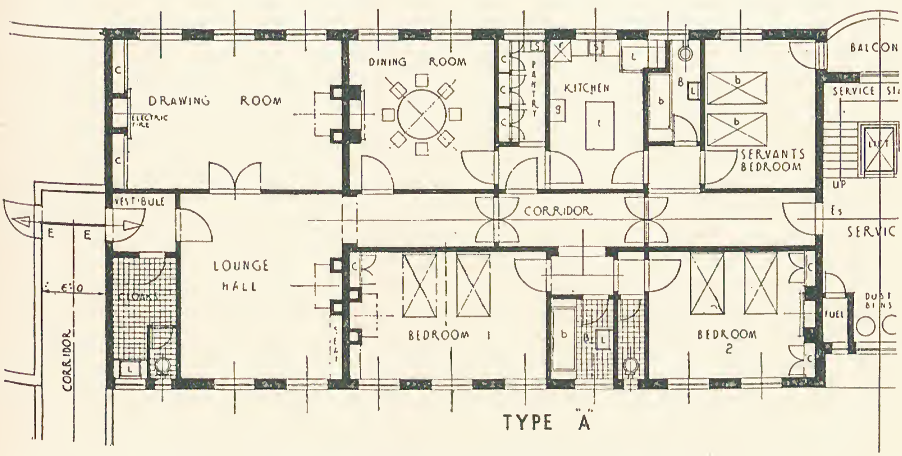


Fig. 5.—A WELL-PLANNED HIGH-RENTAL TYPE OF FLAT

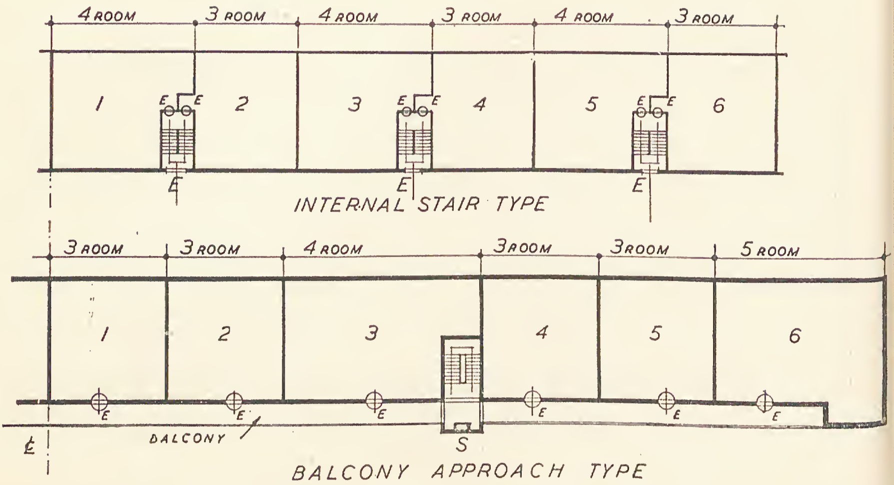


Fig. 6.—PLANNING FOR TENEMENT FLATS

(5) Service from kitchen to dining-room via a pantry without crossing main corridor.

(6) Disassociation of bedroom quarters from rest of the plan.

(7) Bathroom adjacent to bedrooms and separate w.c.

(8) Good light and ventilation to the whole flat.

(9) Good, wide corridors.

The foregoing article has of necessity been limited to the general principles of sound planning as applied to flats. The housing of a large number of people in a relatively small area does create problems which hitherto have not been encountered. The main essentials conducive to a proper solution of the various problems must be carefully studied. It will be appreciated that constant changes in social standards, personal requirements, standards of living, hygiene, construction and materials make it impossible for flat-planning to remain static or standardised.

TENEMENT FLATS

Tenement flats are now accepted as being the only solution of the rehousing problem in certain circumstances, namely in extremely congested areas where land for rehousing is either unobtainable or prohibitive in price, and where it is not considered practical to rehouse the people long distances away from their employment. Any scheme for slum clearance presents two important but opposing problems, namely that of increasing and improving the standard of accommodation, and yet at the same time lowering constructional costs and thereby rentals.

Sociological considerations do not fall within the scope of this article, which is principally concerned with details of planning and design.

Standardisation

The only way in which building can be reduced to absolute minimum cost is by strict and rigid standardisation of unit. The whole of the plan must be conceived in terms of standardised units whose component parts are in turn standardised.

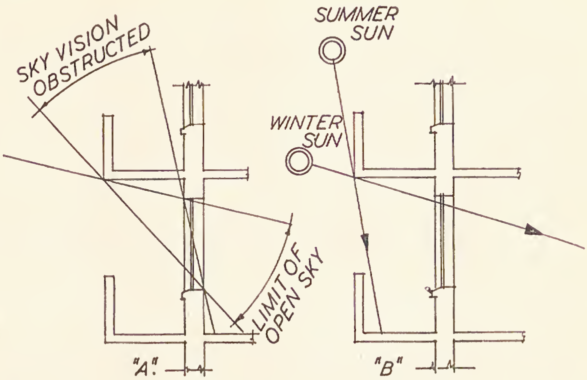


Fig. 7.—OBSTRUCTION OF SUN AND LIGHT BY PROJECTING BALCONIES

Flat Unit

The fundamental requirements of a tenement flat unit are quite different from those of other flats. A relatively large family has generally to be housed. It is perhaps unfortunate yet nevertheless true that the poorer classes of society who can least afford it are the most prolific. It is found there is little demand for the small single-room type of flat and a unit for housing parents and three or four children is in greatest demand. The actual arrangement of rooms is very similar to that in other flats, though economy of space and equipment is now a primary factor.

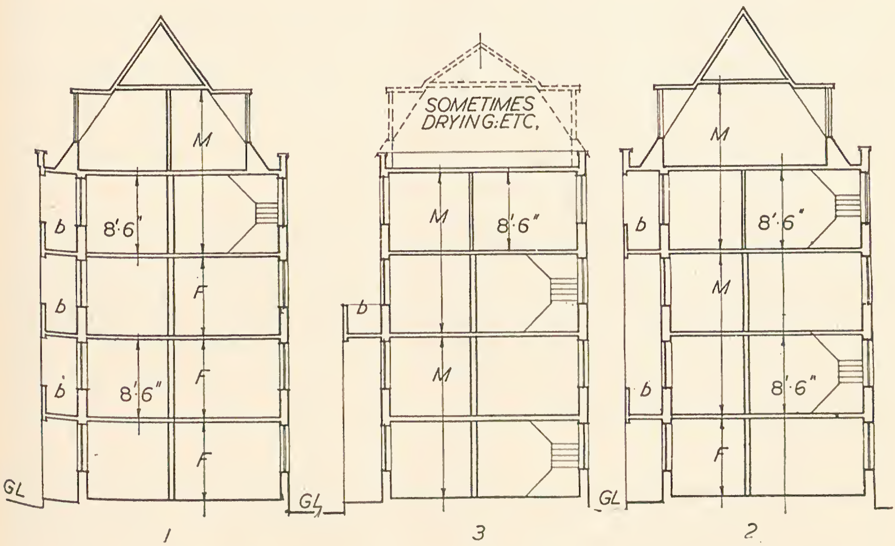


Fig. 8.—SECTIONS THROUGH VARIOUS TYPES OF BALCONY-APPROACH SCHEMES

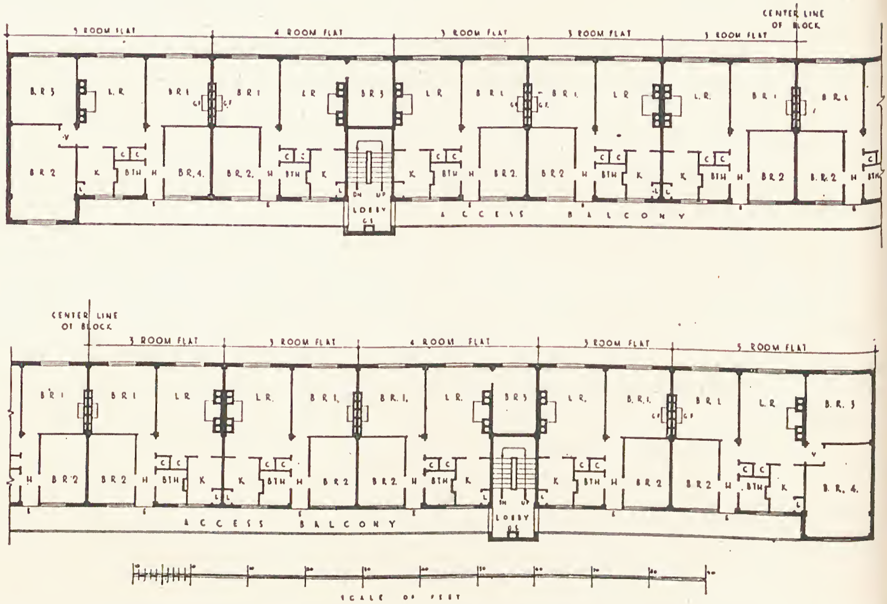


Fig. 9.—ALTERNATIVE LAYOUTS FOR A FIVE-STOREY BLOCK OF TENEMENTS, COMPRISING FIFTY FLATS SERVED BY BALCONY APPROACH

These comprise three-, four-, and five-room flats.

Minimum Room Sizes

Economy of space necessitates elimination of internal corridor and vestibule circulation ; rooms are entered direct from other rooms, with a consequent reduction in comfort and privacy. The rooms themselves cannot be large, though the following sizes may be considered definitely as minima :—

Living-room	150 sq. ft.
1st Bedroom	125 sq. ft.
2nd Bedroom	95 sq. ft., 2 persons.
3rd Bedroom	65 sq. ft., single room.

Financial considerations usually prevent much variation in room sizes. Each flat should have a bathroom, kitchen and larder, and this service portion of the flat must be reduced to a minimum consistent with efficiency, and all mechanical equipment must be as simple as possible and standardised throughout the whole block.

The Kitchen

The kitchen in this case must be large enough to provide proper space for cooking and yet must be small enough to discourage its being used as an extra living-room.

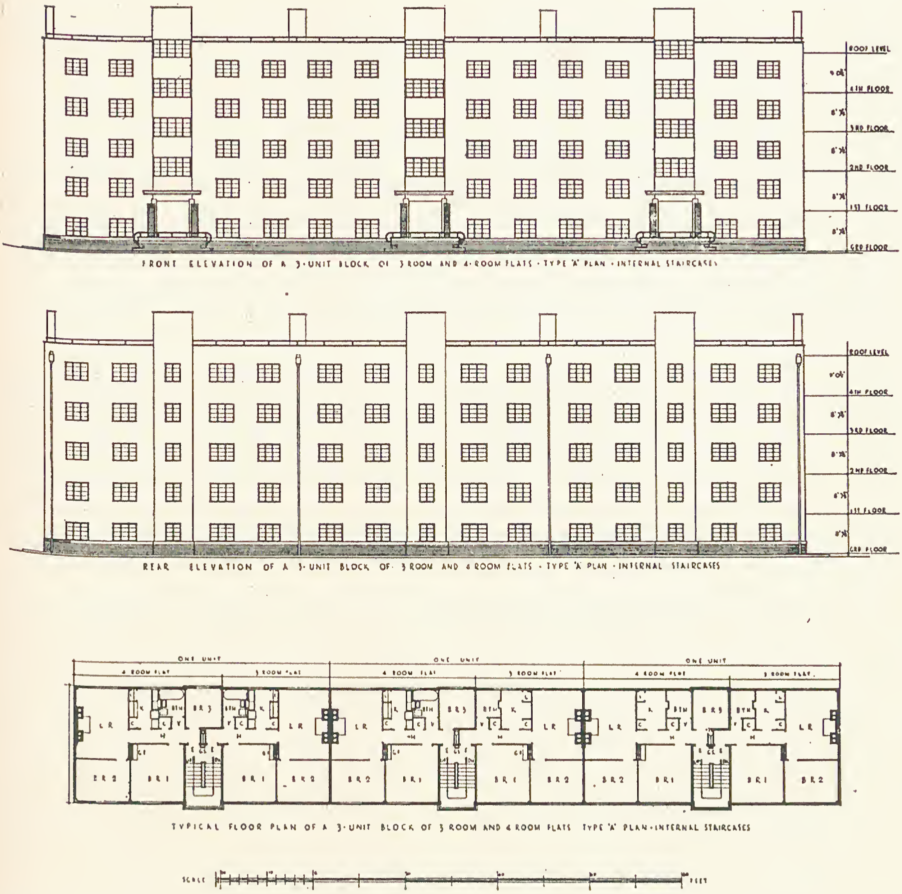


Fig. 10.—TYPICAL BLOCK OF THIRTY TENEMENTS, FIVE STOREYS HIGH, AND OF THE INTERNAL STAIRCASE-APPROACH TYPE

To date the most economical building emanates from a plan in which individual flat units suit an economic bay in a framed structure. This is well illustrated in Figs. 9, 10, and 11, which comprise suggestions put forward by the Council for Research in Housing Construction.

Types of Plan

In general there are two types of development :—

(A) The balcony-approach scheme.

(B) Internal-staircase type (Fig. 6).

In the first case access is provided to the flats by running balconies at each floor level the whole length of the building with access stairs at specific points—generally at the ends of the building. It will be appre-

ciated that this arrangement allows maximum flexibility of planning in the arrangement of flat units. The number of staircases is reduced to a minimum.

Lift Equipment

Should high blocks of tenements, i.e. eight to ten storeys, be built in the future there is no doubt that the lift installation which would be necessary would have to be incorporated with balcony approach in order to limit the number of lift batteries.

The Balcony Problem

However, although possessing the merit of economy, the balcony approach scheme has several disadvantages. It necessitates constant passing to and fro of tenants beneath some of the windows in every flat. This may not be serious if kitchens and bathrooms are confined to the balcony side—usually at least one bedroom, however, occurs on the balcony side. The projection of the balconies themselves is apt to detract from the light to windows below, though again this may not be serious if such windows are mostly service windows (Fig. 7).

The balcony is usually formed by extending the floor of the flats on one side to form a cantilever, the end being turned up to form a balustrade. The solid balustrade is better than an iron rail. Experiment has shown that it proves less dangerous for children ; it also permits a gutter being formed to facilitate swilling down of the balcony without disfiguration of the building and annoyance to tenants caused by water dripping down from above. The solid balustrade affords a measure of protection against inclement weather, and some prefer its appearance to that of the open rail.

Balconies should not be less than 3 ft. 6 in. in width. A further point worthy of note is that an external balcony facilitates the clearing away of refuse by means of chutes. These can be placed in convenient positions and their number reduced to a minimum. Staircases giving approach to balconies must of course be of fire-resisting material and may be placed in angles of the plan which do not receive sufficient light for actual flats.

Some Typical Examples

There are several variations on the balcony-approach type of plan. The maximum height in cases where no lift is provided is five floors. Possible variations are shown in (Fig. 8) :—

(1) The block may comprise three floors of flats, the upper two floors being maisonnettes. Balconies are necessitated only at first-, second-, and third-floor levels (Fig. 8—(1)).

(2) Flats may be planned on the ground floor only, the upper floors

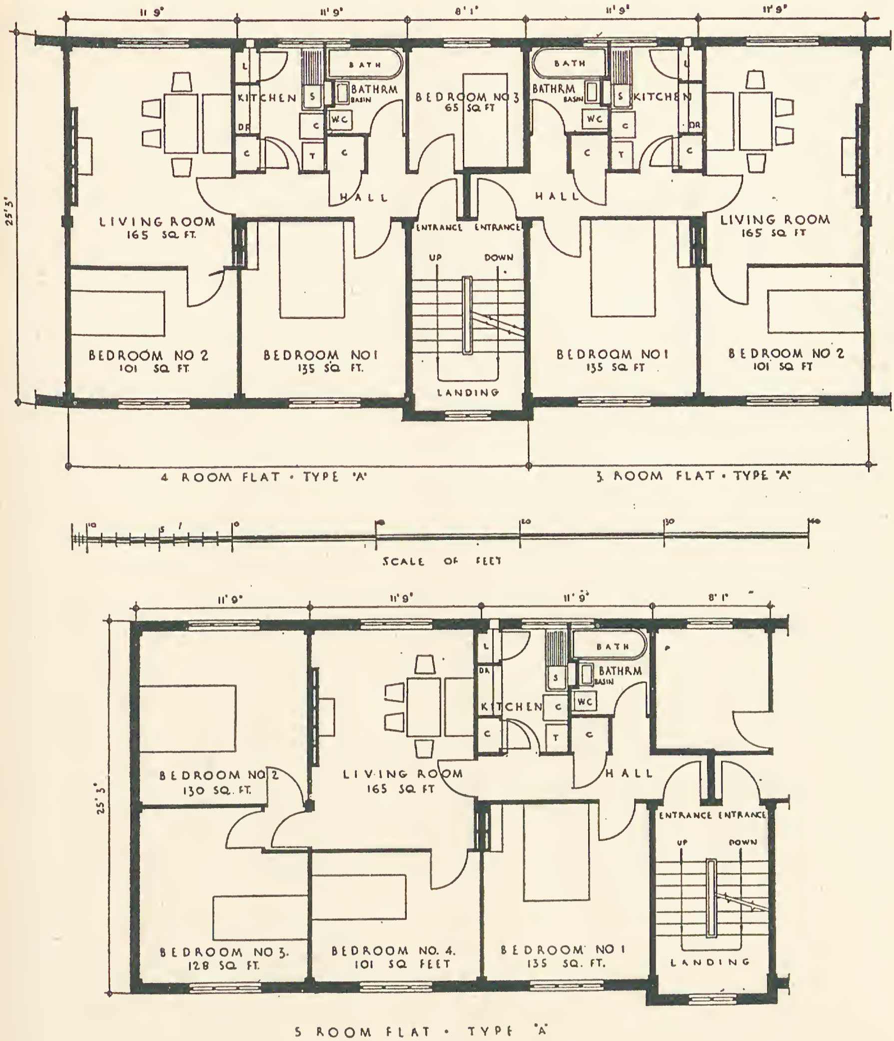


Fig. 11.—Arrangement of individual flats comprising three, four, and five rooms. Internal staircase approach

comprising two floors of maisonnettes (Fig. 8—(2)). This means placing balconies at first- and third-floor levels. The ground-floor flats are suitable for aged and infirm people.

(3) A further type consists of a block only four floors high comprising two floors of maisonnettes. This requires a balcony at second-floor level only (Fig. 8—(3)).

Internal-staircase Type

This type of plan consists of an internal staircase serving two flats per floor. It affords more privacy to individual flats, though the increased number of staircases takes up a great deal of space and does not allow as great a flexibility of planning as in the balcony-approach scheme. The arrangement does, however, allow the flats an outlook on each side and avoids the problem of balconies passing windows of the flats. This type of development does much to retain a domestic character to the scheme, which is difficut when balconies are used, as an institutional appearance is difficult to avoid (Fig. 6).

Equipment

As in other types of flat, careful consideration and standardisation of mechanical equipment offers the most scope for reduction in building costs. In tenements, plumbing and sanitary services require particular attention. Sanitary units should be grouped vertically over one another to allow straight drops for stack pipes. Horizontal grouping reduces the number of stacks to a minimum. Internal ducts properly ventilated and with adequate inspection points should be provided for the main stack pipes. Sanitary fittings should be placed as close as possible to the duct, at the same time allowing for standard connections which eliminate waste of both material and time spent in fixing. Actual fittings should of course be standardised throughout the scheme to type and size.

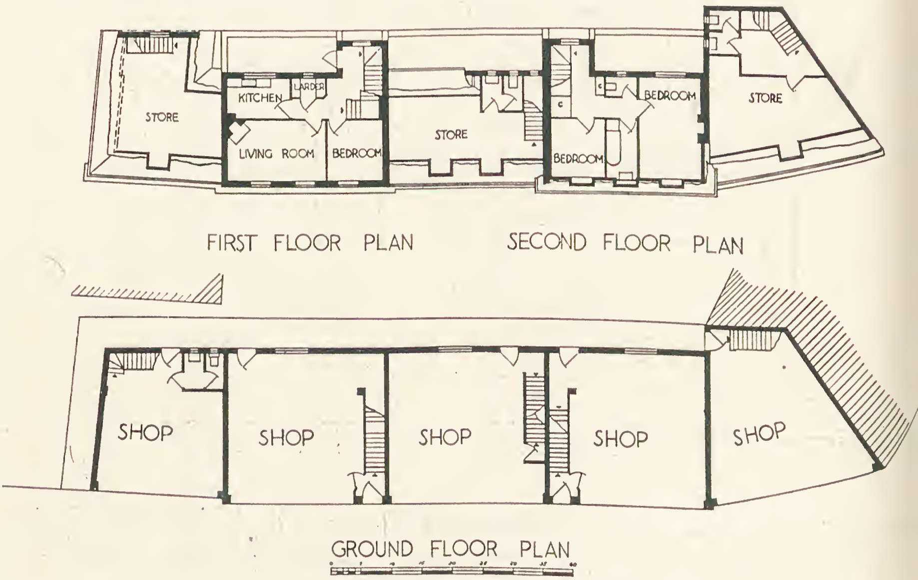


Fig. 12.—PLAN SHOWING ARRANGEMENT OF FLATS OVER SHOPS

It will be seen that the entrance to the flats is by the side of the shops. (*Architects: Oakley and Sanville.*)

Fig. 13.—Block of flats in Drayton Gardens

(*Architects : Hoare & Wheeler, FF.R.I.B.A.*)

Fig. 14.—An interesting arrangement of flats over an arcade, in which the top floor is divided into a number of small "all-electric" flats, with an entrance off the arcade.

The building is steel-framed, with fireproof floors and asphalted roofs. (*Architects: Thomas Garrett & Son.*)

QUESTIONS AND ANSWERS

What are the two main types of development for Tenement Flats?

A. The balcony-approach scheme.
B. Internal-staircase type.

What are the features of the Balcony-approach Scheme?

Access to the flats is provided by running balconies at each floor level the whole length of the building, with access stairs at specific points—generally at the ends of the building.

How is the Balcony usually Formed?

By extending the floor of the flats on one side to form a cantilever, the end of which is turned up to form a balustrade.

What are the features of the Internal-staircase Type?

This type of plan consists of an internal staircase serving two flats per floor. It provides more privacy to individual flats, but the increased number of staircases takes up a great deal of space.

THE DESIGN AND PLANNING OF GARAGES

ONE of the greatest problems confronting authorities to-day is that of planning to relieve the congestion of traffic, and the primary cause of this congestion is just being realised. The traffic in the streets of a busy city may be likened to blood coursing through the arteries of a living organism: a congested flow indicates a state of "high blood-pressure" which can eventually threaten the health and proper growth of the city. In order to relieve this pressure all obstacles must be removed, so that vehicles will be able to move faster and unhindered. The widening of streets to ease congestion attracts an increased circulation, but can lead to an even greater congestion than before. Therefore, if the streets cannot take the parking of cars which constitutes one of the greatest obstacles, garages in number to accommodate the stationary vehicles are a necessity.

Growth of Modern Traffic

The growth of the motor-car industry since the war has been phenomenal. The limit of the usefulness of mechanically propelled vehicles has not yet been reached, while no saturation-point of manufacture and sale of motor vehicles for business and pleasure is apparent. In fact, saturation is likely to be determined sooner by the size and capacity of the town streets, or by restrictive legislation, taxation, etc., than by the purchasing power of the community. The public take more pride in the performance and appearance of their cars now than formerly, and require them to last longer. Street parking is, although temptingly convenient to the individual, dangerous, and complicates the difficulties which confront the police, fire brigades, and other services. It is only the city garage which can alleviate the position by housing temporarily most of the cars otherwise stationary on the streets, and will free the carriageway for the flow of vehicles that is constantly being augmented. As car sales increase, the demand for showrooms and repair workshops becomes more urgent, so that these components or subsidiaries of the trade contribute to the successful design of a successful garage and business.

Sites for Commercial-vehicle Garages

The foremost question is location and siting, and the requirements of site vary with the purpose for which the building is intended. The

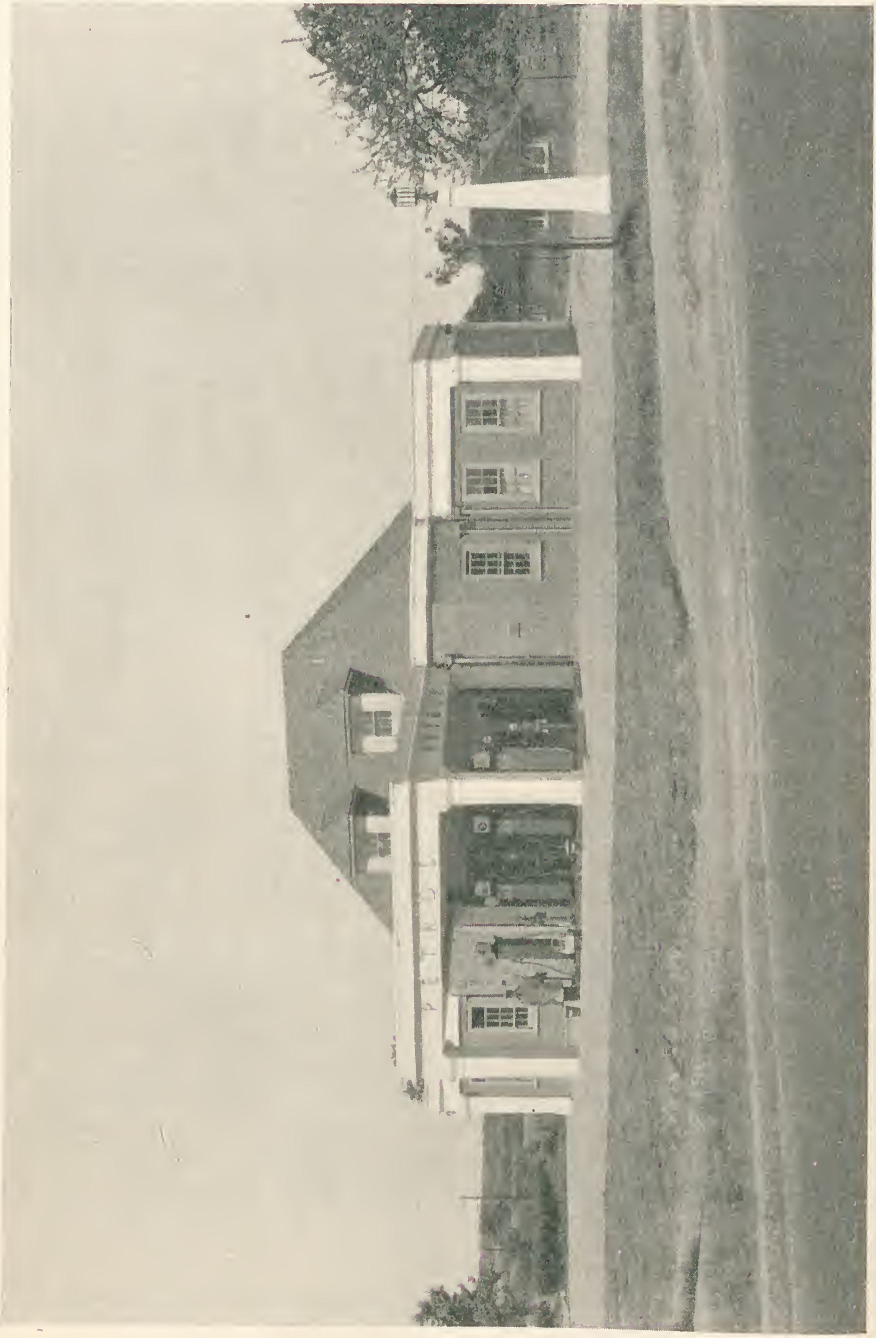


Fig. 1.—A MODERN GARAGE AND PETROL-FILLING STATION (*Architect: Langley Taylor, F.R.I.B.A., F.S.I.*)

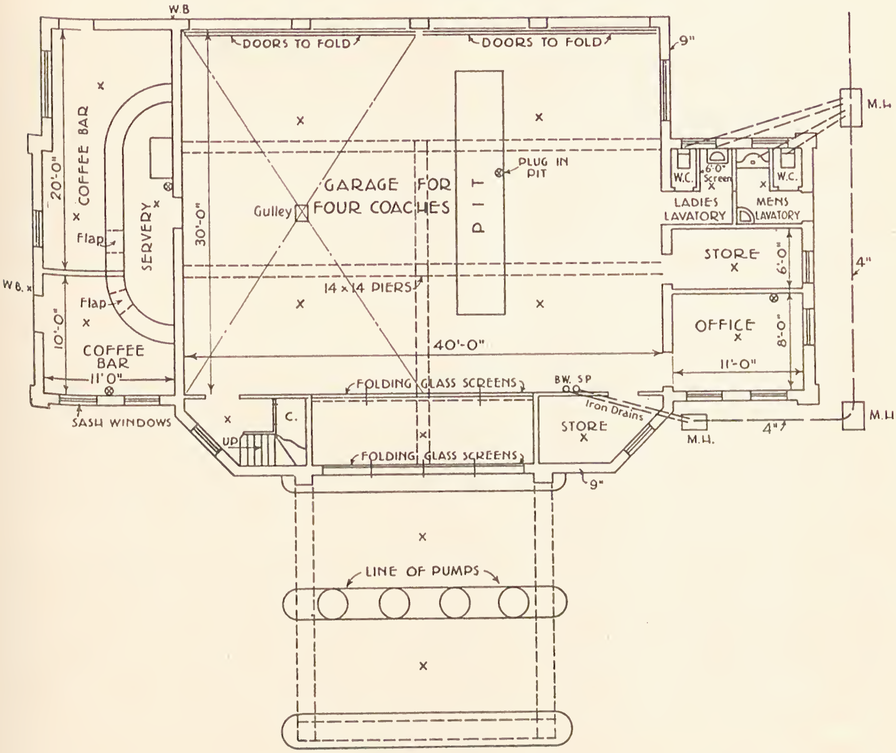


Fig. 2.—GROUND-FLOOR PLAN OF GARAGE AND PETROL-FILLING STATION.
(*Architect: Langley Taylor, F.R.I.B.A., F.S.I.*)

storage and maintenance of commercial vehicles usually dictates a different choice from that for private cars. The location for the use of commercial cars is largely dependent on the character of the owner-user's business.

For example, a firm of goods carriers requires a central position. The vehicles after collection can merge on to this focal point, where their loads are sorted for distribution to final destinations whilst the vehicles are serviced or stored.

A business to which considerable lorry accommodation is essential is the large retail shop that possesses packing and dispatching departments.

In the case of large West End stores, usually occupying an island site, the street parallel to the main frontage provides a way suitable for vehicular entrance and exit.

The garage requiring careful deliberation as to site is that designed for use of passenger transport—the coach station. It is important that the building is related to the railway termini in such a way that passengers disembarking from trains and wishing to continue their journey by road may do so with the minimum of effort or uncertainty of direction.

Planning Commercial Garages

The planning requirements of garages vary as widely as the siting. For the commercial vehicle a building is required for all-comers' cars, whose drivers are skilled and usually know the routine. In the case of the goods carriers, loading and unloading space is usually required in addition to space allocated for storage and maintenance. The passenger-commercial type must include space for the storage of vehicles used on the streets for public hire, such as buses and taxi-cabs, together with service and maintenance ; while for the coach station, public circulation, with or without the above, must be the controlling factor.

Sites for Private-car Garages

The siting of garages intended for the use of private cars presents a more difficult problem : the motoring public, who are its customers, are not confined to the use of any particular establishment. At the best, the private-car storage type is always near, but not at, the nodal points of traffic circulation, such as the entrances to towns, or in the amusement, shopping, and business quarters.

For the first case it is important that the site is related to a public transport terminus, such as a railway or underground station, in order that people who have motored from country to town can deposit their own vehicle and complete their journey through the obstructed streets of the built-up area by local train. This type of garage has " peak " periods of activity, and it is essential to secure a site that does not create, by the position of its doors, special congestion by interrupting the flow of street traffic.

With regard to the second case, while hotels produce only a moderate and steady business day and night, places of amusement bring large numbers, especially at night. Probably the shopping district provides the best flow of all, but where this can be combined with the trade arising from the theatre district, the ideal is most nearly attained, i.e. a twenty-four-hour continuous demand.

Economical and Operating Points of View

The exact location of a garage of this type needs thought from both the economical and operating points of view. A garage in an important city street is not practicable, partly on account of the high cost of land, and partly because the heavy traffic of the rush hours hampers the quick clearing of exits. Moreover, in order to produce a profitable investment, the cost of construction must be kept as low as possible, necessitating the cheapest materials and finishes consistent with maintenance. Being " factory " in function and character, it looks its part, and therefore out of place adjacent to public and office buildings, stores, etc., occurring on the most important streets.

There exist exceptions, but these would have often been more profit-

ably placed on a site nearby but off the main streets. All these reasons emphasise how unfeasible certain prominent kinds of site are, yet the chief characteristics must be accessibility and obviousness from the main traffic routes. The prospective user, rather than having to search for a garage, should find it presenting itself without much effort on his part.

The relation between good frontage and commodious rear area is partly dependent on the sales side of the business, where, if good show-rooms are required, frontage is essential for the display of as many cars as possible.

The Ideal Spot

Perhaps the ideal spot is that at the corner of a busy street which permits the pedestrian entrances on the more important street and the traffic entrances and exits in the side and quieter turning. Under no circumstances should this side street be one where there is the possibility of restricted traffic circulation such as occurs in a one-way street. The reasons for this are obvious. Besides the possible confusion of orientation, and while people do not object to driving their cars for reasonable distances down a street, when they enter or leave the building on foot it is important that the entrance or exit should be as near the traffic entrances or exits as possible, and easy to identify from any direction. A corner plot also permits conspicuous arrangement of petrol station, which is both profitable and desirable.

Two Frontages on Parallel Streets

The site which permits frontages on two parallel streets, with entrances and exits on each, also offers possibilities, and although not having the advantages of a corner, it does draw customers off two streets, and the speed of handling is not affected by temporary traffic blockades in one of them. If a single-frontage plot is exploited, care must be taken for adequate safeguards and proper circulation of traffic to the entrances from, and from the exits into, the main stream.

Suburban Garage and Service Station

A different type of business is that of the suburban garage and service station, which caters for the week-end car user, and the placing of this may not be of such vital importance to its success. Any position reasonably near the residential part of the suburb, with good accessibility to and from a main road, will suffice; here the personal aspect of service goes far to make or mar its ultimate prosperity.

Planning Private-car Garages

The garages which cater for private cars offer storage with service, and occur as independent buildings, with or without showrooms for the sale of new and second-hand cars, or are attached as subsidiary to hotels,

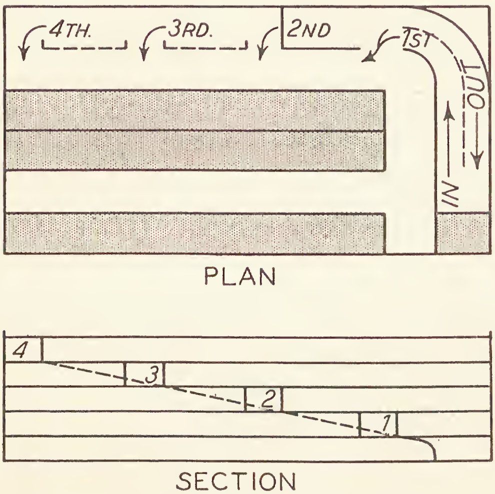


Fig. 3.—STRAIGHT DOUBLE RAMP

flats, stores, etc., where only storage, coupled sometimes with the sale of petrol and oil, is offered. Lastly, there is the establishment, concerned chiefly with the private-car user, which sells only petrol, oil, tyres, and accessories, offers service in the form of repairs and maintenance, but has no provision for the storage of vehicles.

Essentials of the Plan

The operation of a city service garage is attended with so much competition that it requires the most carefully and ingeniously thought-out planning and equipment to render it economically possible at all. The essentials of the plan are : (*a*) the space required for the storage of vehicles ; (*b*) space for service, comprising clear floor area for repairs, together with its necessary rooms for spare parts storage, battery charging, car-washing space and plant, and grease ramps, etc. ; (*c*) petrol station for the sale of petrol, oil, and other accessories, and free service, such as air and water ; (*d*) sales section with showrooms, offices, waiting-rooms, and lavatories for both sexes. All these elements are related to each other and under the charge of the administrative section.

SYSTEMS OF PLANNING

Single Floor and Multi-floor

The systems of plan may be considered under two general headings, the first being single storey, and the second multi-floor. Where land is cheap the single storey, with its low cost of construction, usually answers—an extensive open area of floor with good circulation between, to, and from the smaller rooms. The planning of a multi-floor garage is more complicated, with the various systems for conveying the car from floor to floor. Usually this type of building is on a site the cost of which is so high that the maximum of cars must be accommodated at the minimum of constructional and operating cost.

Ramps or Lifts ?

On the whole, the ramp system probably represents the only solution of the exit of several hundred cars within a few minutes each day, an impossibility with the only alternative—a system of lifts. Lifts have the

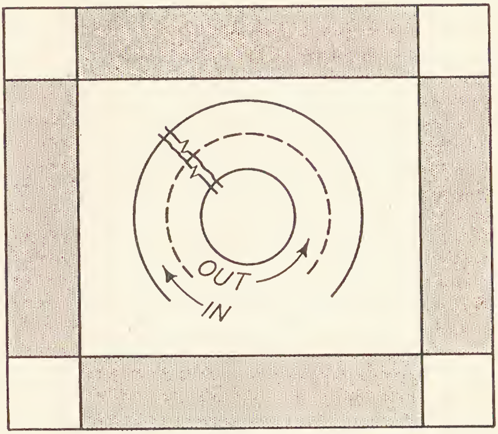


Fig. 4.—CONTINUOUS CONCENTRIC CURVED RAMP

slight advantage over ramps that the floor area taken up for vertical circulation is smaller and therefore more room can be given up to car storage, but the pressure and haste demanded at the morning, midday, evening, and theatre closing-time, and the number and costs of lifts necessary to cope with peak activity, more than offset any such saving.

Experience has proved that unless the site area is very small the use of ramps is preferable. The initial cost of a ramp is very little more than that of a level floor, and there are no machinery repair, upkeep, or running costs, while the customers pay for the moving of their cars with their own fuel! The cost of lifts is high, as are their maintenance and running costs, which have to be borne by the garage owner. Ramps permit many cars to be in motion at one time, whilst with the alternative the number of cars is limited to the number of lifts, and when there is delay in loading and unloading, congestion ensues.

Types of Ramps—Straight Double Ramp

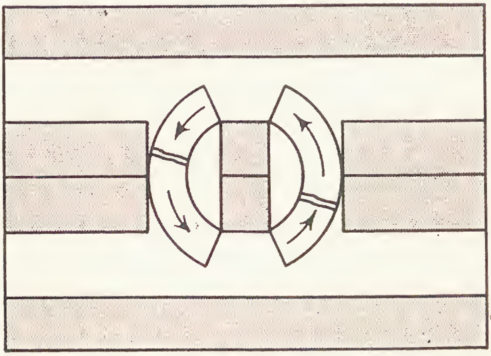
There are many systems of ramps in operation, each having its advantages and disadvantages. The simplest of these is the straight double ramp which runs along the length of one side of the building, with openings at intervals leading off at each floor level. When a site is long enough in one dimension to permit of this it is an economical system, from the points of view of both building cost and loss of storage space.

Concentric Curved Ramp

A variation which can be used on a site of more or less square dimensions is a continuous concentric curved ramp placed in the centre of the site, which allows of access at a certain point of the arc at each floor level. In this system the planning is wasteful, as the corners of the floor area are difficult to utilise, as are also the spaces enclosed by and around the ramps. This scheme may be less extravagant if used for a long site, the ramps being placed near the entrance or at the extreme ends.

Double Spiral Ramp

A further modification is the double spiral ramp on which traffic cannot meet. Satisfactory in space economy and ease in control, it is



PLAN

Fig. 5.—Double spiral ramp

designed on the principle of the double escalier, up-traffic travelling in one sweep and down-traffic on the other, and both ramps use the same area needed for a single ramp of similar diameter.

The Use of Short Ramps

Another type is one where the floors are staggered. The building is divided into halves, one half being half a floor higher than the other, the different levels being connected by short ramps. Great efficiency is obtainable here through the high proportion of space for car storage to the total area, while the handling of traffic is easy and smooth. Another advantage is that one half of the lowest floor is half a floor higher than the other half, thereby giving a floor area of greater height than normal, capable of housing commercial vehicles or showrooms. A drawback is its uselessness for most other purposes should the building cease to operate as a garage, whereas in the case of floors being level throughout, the ramps can be removed and replaced with floors without difficulty.

The Warped-floor Type of Garage

A further development of the last system is the " warped "-floor type of garage, where the floors are laid throughout to a slight ramp, the cars standing on the sloping surface. The benefits obtained here are the low gradients utilised and the good visibility for drivers, who in driving across the floor rise to next floor level at the same time. The cost of construction is lower than that of those previously described, on account of the constant pitch of the floors without the sharp banked corners necessary to ramps. In America this design is very popular, proved to be very satisfactory, and has a negligible upkeep cost.

The Hoenig System

A system which must not be overlooked is the patented Hoenig system, which has been developed abroad. It consists in principle of a large circular ramp which rises steadily, discharging traffic at the various levels on four points each at right angles to each other ; in other words, one rises one floor through 90° or four in the complete circle, thereby gaining greater accommodation over the whole site.

Best Position for Ramps

It is important that ramps should be as far as possible from the entrance or exit of a building in order to leave the maximum aisle space

and storage on the ground floor for manœuvring during rush hours. Cars cannot always be taken to upper floors as fast as they come in, which means that some must stand aside until they can be moved later. Observation has proved that while there are some people who insist on driving their own car to its storage berth, most are reluctant to proceed beyond ground floor. Even so, there is a limit to the number of floors which any customer is willing to mount.

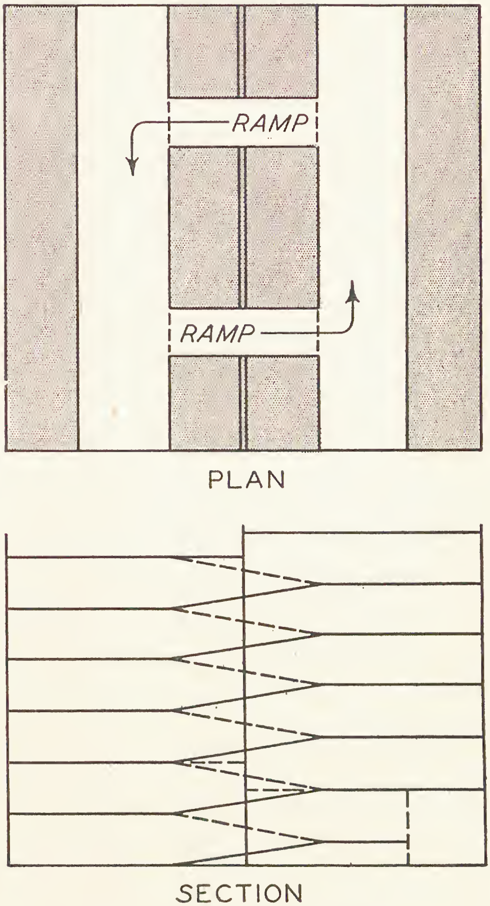


Fig. 6.—STAGGERED-FLOOR TYPE

Notes on Lifts

Despite the all-round superiority and adaptability of ramps, some owners insist on the provision of lifts because of the smaller loss of floor space. Apart from their economic disadvantages, already discussed, the placing of these units in relation to the floor plan often calls for further apparatus; for example, turn-tables may be wanted to move cars directly into the line of approach. Their placing, however, is governed by the same principles as those applying to ramps.

Generally, lifts should be placed as far as possible from entrances, in order to give the maximum space for manœuvring the cars. There are, none the less, several instances where they are placed at the entrance, so that vehicles may drive directly on to them. Sometimes a turn-table is installed inside the lift cage and two or more entrance gates provided, so that the car can be turned in the direction of that portion of the floor to which it is allocated, whilst being hoisted.

Making Use of the Roof of a Multi-floor Garage

The roof of a multi-floor garage may be used for the purpose of open-air parking at lower charges than are made for the covered floors. Access is

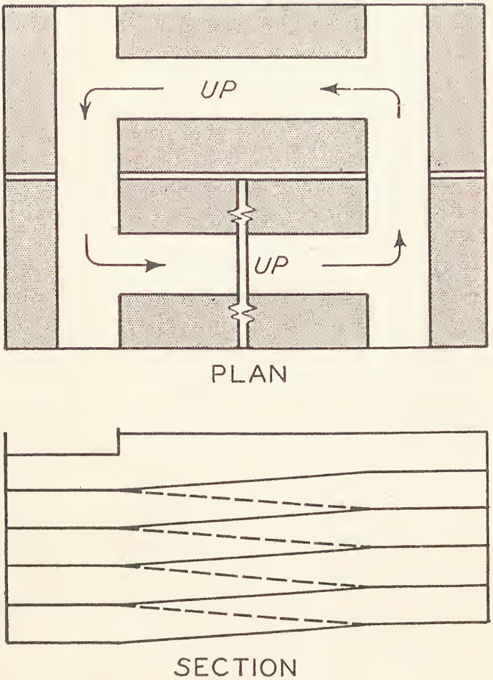


Fig. 7.—“ WARPED ”-FLOOR TYPE

easily obtainable by continuing the ramps or lifts to the roof level, but precautions must be taken against rain running down ramps by roofing over and enclosing the outer side right up to the end, to shelter the floor below. It is desirable to have a high parapet wall around the building at roof level as a protection to the adjoining property in the event of fire.

Underground Garages

Distinct from the single-storey and the multi-floor garage, the possibilities of the underground garage must not be overlooked. Certain tube stations in London have shown us how valuable space can be utilised under the squares and open spaces: it is only one step further to provide for garage or car-parking facilities in a similar manner. The great disadvantage is the high cost of construction, together with the large proportion of the available area which must be given up to access and egress. Furthermore, there would be considerable difficulty in excavating and building in such a manner that the superficial appearance of existing layouts should not be seriously disturbed or changed.

Units and Dimensions Which Influence Planning

A study of car sizes and the amount of floor area required for storage shows that an aisle with cars parked on either side should not be less than 50 ft. or more than 55 ft. Therefore, a garage should be planned in multiples of 50 ft., in one direction at least; thus, in a site, say, 80 ft. wide, there would be an inevitable and excessive waste of space. The economic distancing of columns is important; their elimination is of no advantage in itself, because of the difficulty of maintaining definite stall divisions and the consequent loss of space. There are two systems available, each dependent on circumstances.

The Two-car Bay

If the public park their cars themselves, the two-car bay is preferable as it minimises the amount of damage due to the unskilled driving of the average owner in reversing, etc., while parking.

The Three-car Bay

If, on the other hand, there are attendants to do the final handling, a three-car bay is practicable, as such shows a slight saving of space, and will take two commercial vehicles in lieu of three average-sized private cars if the contingency arises. The columns required to support the floors should be placed at least 2 ft. 6 in. within the dimension allowed for the length of cars to permit easy turning. Thus, the normal column spacing between bays should be 15 ft., 21 ft. 6 in., or 28 ft., accommodating two, three, and four cars respectively. Anything between these dimensions is uneconomical.

Grades for Ramps

The practical grade for ramps is 1 in 6 to 1 in 7, giving a rise of floor to floor of about 10 ft. 6 in. in a horizontal run of 70 ft. Any inclines steeper than this are inadvisable, as they result in frequent accidents from poor brakes and driving. For traffic travelling in opposite directions on one wide ramp, a curb separating the up- and down-traffic ways minimises the possibility of accidents.

Radius of Curves

The radius of any curve has to be not less than 20 ft., a figure based on the turning-circle of average-size cars, but 25 ft. is recommended to avoid the risk of damage to wings. The finish of ramps should be roughened to prevent skidding, and in this respect it has been found that the spaces between grooves become slippery due to dirt, and the method is therefore unsatisfactory. The cheapest and most practical finish throughout all floors and ramps is a rough wood-float finish ; the use of a metallic hardener lengthens considerably the life of these surfaces—an important factor in maintenance costs.

Sizes of Lifts

The size of an ample lift is 10 ft. wide by 20 ft. long, involving well-hole of 11 ft. 6 in. by 21 ft. 6 in., although when several are installed in a battery an economy in the latter dimensions can be effected. The usual velocity for a garage lift is 30 to 40 ft. per minute, with higher speeds to facilitate rapid handling during the rush hours ; at any time there should be a sufficient speed to handle twenty-five to thirty cars per hour in one direction to the highest floor level. Turn-tables should be at least 18 ft. 6 in. over all ; they can be designed just long enough to carry the wheel-base of any car (12 ft. 6 in.), but it is preferable to have them as

long as or longer than the over-all length of the car, thus avoiding the possibility of damage to the car itself or to persons standing nearby. For commercial vehicles, at least 35-ft. diameter is essential, and often entail mechanical propulsion.

Floor-to-floor Heights

The floor-to-floor heights are also determined by the proposed use. In the case of the storage of commercial vehicles this should conform to the highest type, but for private cars a head-room clear of the lowest beam of 8 ft. 6 in. is entirely adequate. When storage for both is required, cost may be reduced by limiting certain parts of the lower storeys for the use of the larger. If the ground floor is to be occupied by a showroom, the ceiling height should be greater than elsewhere in the building ; the basement should likewise be lofty when repair workshops and their necessary adjuncts are put there.

Construction of Garages

In the construction of garages the foremost factor is that the building should be fire-resisting and yet not heavy or costly.

Single-storey Garage

A light structure suffices for a single-storey establishment ; steel framework and trusses, brick walls of minimum thickness, and roof finished with corrugated asbestos or similar proprietary material interrupted by glazing in the north lights.

Multi-floor Garage

In the case of multi-floor garages, the relative merits of reinforced concrete and of steel framing play an important part. The former has the advantage that it is cheapest and quickest from the standpoints of cost and erection respectively, but it also has its disadvantages in that column sizes tend to grow very heavy on the lower floors, resulting in loss of floor and storage space where such are most valuable.

Steel-framed Structures

Although more expensive and taking longer to erect, a steel-framed structure is superior in so far that should the property become too valuable as a garage, it is more readily converted to other purposes. Also, with the economical spans already laid down, the sizes of stanchions and beams will be at a minimum. On the whole, the best method for a multi-floor garage is a steel frame with hollow tile or solid concrete floors and ramps, and brick external walls.

FITTINGS AND GENERAL PLANT

Artificial illumination may be confined to rows of lamps 15 ft. to 20 ft. apart in the main ramps and aisles, with a more generous amount at the

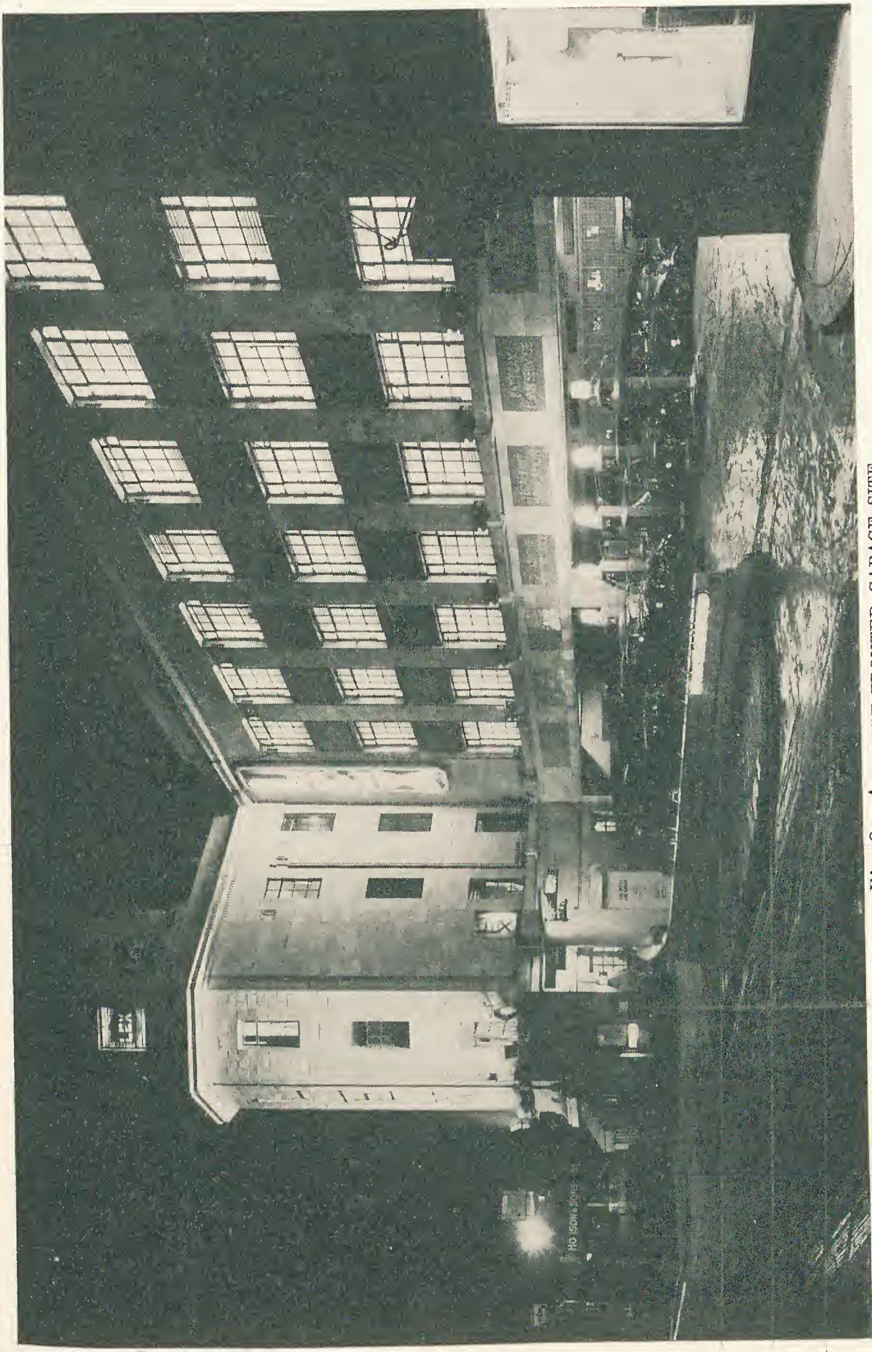


Fig. 8.—A SINGLE-FRONTED GARAGE SITE

With this type of plan, care must be taken for adequate safeguards and proper circulation of traffic to the entrances from, and from the exits into, the main stream.

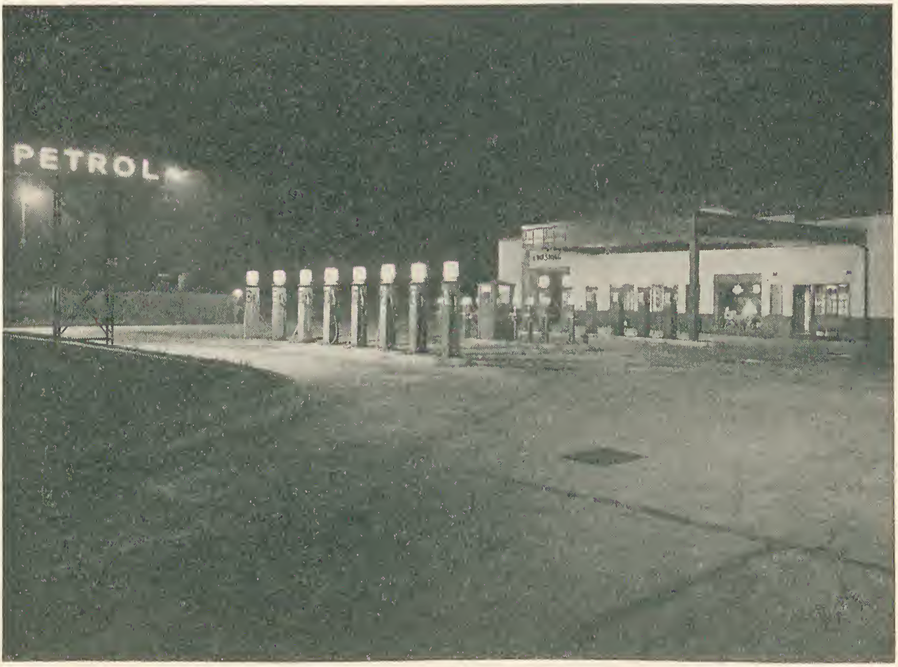


Fig. 9.—GOOD ACCESSIBILITY TO AND FROM A MAIN ROAD IS ONE OF THE ESSENTIALS FOR A SUBURBAN GARAGE AND SERVICE STATION

entrances to the building, and at turnings or changes of level. The lighting on ramps must be arranged to shine as little as possible in the eyes of drivers as they ascend or descend, especially where designed for both up and down traffic. The lamps in the main aisles should be of sufficient power to provide for general purposes over the remainder of the floor area. All electric circuits should be controlled by a master switch at ground-floor level, thus obviating the necessity of an attendant going up to turn the lights off at night, a detail more important than it seems.

Furthermore, the maximum amount of daylight obtainable should be arranged by means of large windows of clear span, having regard to the provision of sufficient solid walling at each floor level to protect the floor above from the direct action of flames in the event of fire.

Heating Installation

An efficient heating installation is necessary in all multi-floor garage buildings, although the temperatures to be maintained need not be very high. 45° to 50° F., when freezing outside, is enough for the storage floors, but the offices and showrooms should have sufficient heating surface to keep 60° to 65° under the same conditions. Low operating costs and

initial installation can be effected by means of fan-driven unit heaters in lieu of hot-water radiators and pipe coils.

For efficient working, one unit should always face each door to the outside, and ample heating at these points eliminates the need for many units on the upper floors. In ramp garages particularly, very little will be found necessary on the upper floors owing to the easy rising of the warmed air along the slopes. It should be remembered that the bottom of the heater must be enough above the floor to afford clearance to the tallest type of vehicle likely to pass underneath.

Ventilation System

A ventilation system is desirable, particularly in basements or on any other floors where through currents of air are difficult to arrange; on upper floors, natural air movement generally suffices. The fumes, which have to be controlled by artificial means, are mostly heavier than air, and should therefore be extracted near floor level, and because of the presence of carbon monoxide should discharge at roof level.

Special Equipment

Specialised equipment includes floor space set aside for the use of car washing and greasing, battery charging, tyre storage, petrol storage, spare parts storage—all of which should be near and leading out of the main repair shops.

Pneumatic Greaser

The pneumatic grease ramp is better than the open pit in the floor, as the latter tends to harbour exhaust gas. Ample space should be allowed for the washing and polishing of cars, for which, as well as for the cleaning of the chassis, a rack raised about 2 ft. off the floor appreciably reduces the labour.

Car-washing Machine

The principal supplementary apparatus here is a car-washing machine, consisting of high-pressure water guns with hot and cold water. The floors of washing spaces should be formed of metal grids through which the water and dirt pass on to granolithic floors laid to falls and discharging into gullies designed for petrol-oil-water mixtures, whilst the mechanics remain on a comparatively dry surface.

Battery-charging and Storage Room

The battery-charging and storage room must be separated from the normal work of the garage by a fire-resisting wall or partition, and in some cases has to be approached from the external air; benches must be covered with lead or other acid-proof tops. Low racks are needed for the storage of distilled-water and acid containers, and further racks and bins for spare parts and new batteries.

Sprinkler System

Against fire risks a sprinkler system is often installed, the water discharged by such having the advantage of smothering petrol fires by the elimination of air necessary for combustion. Sprinkler outlets should be at ceiling level, and the water-supply may be taken directly from the mains or through high-level storage tanks. In addition, extra fire-fighting appliances should be distributed at frequent intervals, especially near the petrol- and oil-storage departments.

Regulations and By-laws

The public authorities and insurance companies enforce very stringent regulations regarding the construction and use of multi-floor garages. Special attention is given to the means of escape ; two staircases, enclosed in fire-resisting materials, allowing direct egress to the exterior, and with an approach on each floor through an open-air cut-off, are required. When of more than one storey, or over 250,000 cu. ft. in volume, each floor has to be cut off from the others by means of automatic fire-resisting shutters or doors. If basements in buildings of more than 250,000 cu. ft. are used for car storage, it is necessary to provide windows from floor to ceiling for at least 30 per cent. of the perimeter of the floor, and made to open on to areas or street frontages as explosion vents. Offices, waiting-rooms, etc., must be partitioned off from storage space by means of fire-resisting partitioned doors.

In the petrol-filling section the storage tanks for the petrol pumps should be placed under the drive-ways, a manhole cover for access being necessary, together with a filling and ventilation pipe, the latter carried up well above the ground. In many districts, pumps and filling caps have to be at least 20 ft. away from the public way and openings to the building, and the filling pipes in such a position that the petrol tank-wagons may discharge into them without obstructing the normal traffic of the garage.

Constructional requirements, not peculiar to the type of building under review, vary with the different codes of by-laws throughout the country, and these should always be ascertained before proceeding with detailed drawings.

In conclusion, two recent Acts of Parliament must be mentioned for their bearing on the problem. The Town and Country Planning Act, 1932, controls the use to which all land can be put, and hence the intending promoter of a new garage would be ill-advised not to consult the local scheme before even purchasing a site, particularly in a non-commercial area. The same Act governs questions of height, coverage, and external appearance, as well as being able to insist on definite arrangements of approaches, service roads, etc.

The Restriction of Ribbon Development Act, 1935, covers very similar matters, with a strong emphasis on the relation of the design to traffic circulation in the adjoining roads.

BUILDERS' ESTIMATING

PART I.—EXCAVATOR, CONCRETOR, AND DRAINLAYER

THE subject of builders' estimating is being dealt with in this volume because the preparation of plans for any building must be largely influenced by financial considerations.

Tables of unit cost values are given in the various trades, with adjustment figures for variations in prices of materials and rates of wages, in order to minimise labour in the adjustment of prices.

Labour values for the main items in each trade, with detailed analyses showing the construction of typical unit prices, are also given.

It will be recognised that the total value of the building, and the amount of repetition work involved, have a distinct bearing upon labour costs. The values given are average values for work without large repetition. Special consideration to labour values is necessary when full advantage can be obtained from the use of large mechanical plant.

The detailed examples are based upon the rates of wages and prices of materials current in the London area. The labour values are based upon those given in the author's text-book (*Builders' Estimating*, Book I, E. D. Clayton).

The prices given throughout the articles are net cost prices. To these prices must be added an allowance for general establishment expenses and profit.

PRELIMINARY BILL

Owing to space limitations it is impossible to deal fully with all the clauses coming within the preliminary bill. Many clauses, such as the provision of watching and lighting, foreman, etc., can readily be calculated according to the duration of the contract.

INSURANCES

Insurances Based on Wages Paid

Insurances in connection with workmen should be treated in the preliminary bill, and not charged as a general overhead expense with ordinary establishment expenses. The insurances based upon workmen's wages are (*a*) Health, Pensions, and Unemployment, (*b*) Workmen's Compensation and allied Acts, (*c*) Third Party insurance.

(a) Health, Pensions and Unemployment Insurance

The employer's contribution to the National Insurances is 1*s.* 7*d.* per week for adult workers. Assuming that the average weekly wage per man is one-half of the combined wages of a mechanic and a labourer, the employer's contribution will amount to 1*s.* 7*d.* for each £3 4*s.* 2*d.* paid in wages. This is approximately $2\frac{1}{2}$ per cent. on the total wages paid.

(b) Workmen's Compensation and Allied Insurances

For normal occupations in the building industry, the tariff rate is 30*s.* per £100 of wages paid. If the builder wishes to cover the risk with regard to his liability in connection with the workmen employed by sub-contractors, the usual premium is one-half of the normal rate. These workmen will be insured by the sub-contractors, and in many cases the builder does not consider it necessary to insure against the slight liability imposed on him.

(c) Third Party Insurance

The normal rate for Third Party insurance is 5*s.* per £100 of wages paid.

Total insurance on wages paid by the builder :—

National Insurances	$2\frac{1}{2}$ per cent.
Workmen's Compensation and allied Acts	$1\frac{1}{2}$ „ „
Third Party insurance	$\frac{1}{4}$ „ „
Total	$4\frac{1}{4}$ „ „

Assuming the total amount of contract is £20,000, including 15 per cent. for overhead charges and profit, the estimated value of the foregoing insurances would be calculated as follows :—

Total amount of contract	£20,000
Less value of work carried out by sub-contractors, say	10,000
Work carried out direct by builder	10,000
Deduct value of materials, say two-thirds	6,666
Value of wages, including 15 per cent. overhead charges and profit ..	3,334
Deduct, say, 13 per cent. to arrive at net cost price	434
Estimated net value of wages	£2,900

Insurance premiums etc. $= 4\frac{1}{4}\% \times £2,900 = £123\ 5s.$

The ratio between wages and materials will vary with the type of building under consideration.

Fire Insurance

The tariff rate for non-hazardous risks is about 2*s.* per cent. per annum. Policies for a less period than one year are charged at slightly more than

the proportionate rate. For large contracts the fire insurance premium is often treated on the basis of a series of short-term policies, based upon the value of work carried out and materials delivered on the site at different periods.

Water for Building Purposes

The method of charging for the water used in building operations varies in different localities.

For the area coming within the jurisdiction of the Metropolitan Water Board, the charge for work of small dimensions may be taken at 7*s.* per cent. on the amount of the contract.

The present rate for water supplied by meter, for a quarterly consumption up to 50,000 gal., is 1*s.* 1*d.* per 1,000 gal., plus a small charge for meter hire. This charge is subject to a minimum quarterly consumption of 20,000 gal.

In addition to the charge for water consumed, the cost of connection to main, meter pit, temporary plumbing, etc., must be added.

There is no method of correctly estimating the amount of water that will be required for the erection of a building, but it may be taken that the cost for the supply of water by meter, for a building value £3,000 and over, will not exceed 2*s.* 6*d.* per cent. on the amount of the contract.

District Surveyor's Fees

Local by-laws should be consulted for any fees payable in connection with building operations. In many districts no fees are payable.

In the London County Council area, fees are payable to district surveyors, and a list of these fees is given in the First Schedule of the London County Council (General Powers) Act, 1928. For new buildings these fees are payable on the " cubical extent " of the building. For a new building, other than a reinforced-concrete or steel-framed structure, of an extent exceeding 5,000 cu. ft., the following fees are payable, plus an additional sum of £1 10*s.* :—

For every 1,000 cu. ft. and also for any fractional part of 1,000 cu. ft. up to an aggregate cubical extent of 1,000,000 cu. ft.	1*s.* 0*d.*
For every 1,000 cu. ft. beyond the first 1,000,000 cu. ft. and also for any fractional part of 1,000 cu. ft.	6*d.*

The Act should be referred to for fees payable in respect of reinforced-concrete and steel-framed structures, alterations and additions to existing buildings, and other fees payable to district surveyors.

EXCAVATOR

Excavators' work on building sites will be carried out by manual labour, except for work of large dimensions.

It will be found that the time occupied in digging, and the increase

in bulk of the material after excavation, vary considerably with the type of soil to be excavated.

Labour values are given for four typical kinds of earth. These values are based upon the net size of the excavation, and the labour due to handling the increased bulk of earth after digging is included in the times given.

The labour values given for "fairly hard soil" should be used, unless an inspection of the site indicates that one of the other types is more applicable.

For cartage purposes, the increase in bulk after excavation may be taken as follows :—

(1) Loose soil	15 per cent.
(2) Fairly hard soil	25 ,,
(3) Compact gravel	25 to 33 ,,
(4) Stiff clay	50 ,,

LABOUR VALUES

	Labourers' Time in Hours			
	1 *Loose Earth*	2 *Fairly Hard Soil*	3 *Compact Gravel*	4 *Stiff Clay*
BULK EXCAVATION (per yard cube).				
Excavate not exceeding 5 ft. deep and throw out	1	2	$2\frac{1}{3}$	$2\frac{3}{4}$
Each additional throw of 5 ft.	$\frac{1}{2}$	$\frac{3}{5}$	$\frac{3}{5}$	$\frac{3}{4}$
Fill to barrows and wheel not exceeding 20 yd.	$\frac{3}{4}$	$\frac{4}{5}$	$\frac{4}{5}$	1
Wheeling, each additional run of 20 yd. . .	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{2}$
Loading to vehicles for removal	$\frac{1}{2}$	$\frac{3}{5}$	$\frac{3}{5}$	$\frac{3}{4}$
Basketing, including removing 20 yd.	1	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$
Extra for depositing in bulk in making up ground	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
TRENCH EXCAVATION (per yard cube).				
Excavate not exceeding 5 ft. deep and throw out	$1\frac{1}{4}$	$2\frac{1}{2}$	3	$3\frac{1}{2}$
Each additional throw of 5 ft.	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{7}{8}$
Fill and ram to drain trenches, etc.	$\frac{3}{4}$	$\frac{9}{10}$	$\frac{9}{10}$	$1\frac{1}{8}$
,, ,, ,, around footings	1	$1\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{1}{2}$
SURFACE EXCAVATION (per yard super).				
Extra over bulk excavation for digging to areas 12 in. deep and under	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{4}$
Spreading and levelling earth 6 in. thick . .	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$	—
,, ,, ,, ,, 9 in. ,, . .	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	—
,, ,, ,, ,, 12 in. ,, . .	$\frac{2}{5}$	$\frac{2}{5}$	$\frac{2}{5}$	—

Typical Examples of Detailed Price Analysis

The following examples are all based upon "fairly hard soil" :—

			s.	*d.*
(1)	*Bulk excavation not exceeding 5 ft. deep, and throw out.*			
	Labourer, 2 hours	@ 1*s.* 3*d.*	2	6

(2) *Bulk excavation exceeding 5 ft. and not exceeding 10 ft. deep, and throw out.*

Excavate not exceeding 5 ft. deep ..	Labourer 2 hours		s. d.
One additional throw	" $\frac{3}{5}$ "		
	Total $2\frac{3}{5}$ "		
Labourer, $2\frac{3}{5}$ hours		@ 1s. 3d.	3 3
Allowance for staging			3
		Per yard cube, net	3 6

(3) *Cart surplus earth.* (*a*) When vehicles can be loaded at point of excavation.

Loading, labourer $\frac{3}{5}$ hour	@ 1s. 3d.	9
Cartage of 1 yd. cube, net, plus 25 per cent. increase in bulk, $1\frac{1}{4}$ yd. cube	@ 3s. 0d.	3 9
	Per yard cube, net	4 6

(4) *Cart surplus earth.* (*b*) When earth has to be wheeled 20 yd. before loading.

Fill barrows and wheel	Labourer $\frac{4}{5}$ hour		
Load to vehicles	" $\frac{3}{5}$ "		
	Total $1\frac{2}{5}$ "		
Labourer, $1\frac{2}{5}$ hours		@ 1s. 3d.	1 9
Cartage, $1\frac{1}{4}$ yd. cube		@ 3s. 0d.	3 9
		Per yard cube, net	5 6

(5) *Excavate* 9 *in. deep and throw out.*

Basis price per yard cube, 2s. 6d.

9)36 in. = $\frac{1}{4}$ yd. cube..	@ 2s. 6d.	$7\frac{1}{2}$
Extra labour to surface excavation, labourer $\frac{1}{5}$ hour ..	@ 1s. 3d.	3
	Per yard cube, net	$10\frac{1}{2}$

(6) *Return and ram around footings.*

Labourer, $1\frac{1}{3}$ hours	@ 1s. 3d.	1 8
Load and cart surplus earth (example No. 5), $\frac{1}{6}$ yd. cube	@ 4s. 6d.	9
	Per yard cube, net	2 5

(*Note.*—The excavated material will not consolidate to its original bulk after returning and ramming, and about $\frac{1}{6}$ yd. cube of Class 2 soil will need to be removed.)

Planking and Strutting

Planking and strutting to support the sides of the excavation will vary in value with the type of soil and the depth and character of the excavation.

The following may be taken as reasonable values for the labour in erection and removal of the timbering, and the charge for its use and

waste. The prices are based upon each face of the excavation being measured.

Open planking and strutting to trenches	1*d.* per foot super
Close ,, ,, ,, ,, ,, ...	2½*d.* ,, ,, ,,
Close ,, ,, ,, ,, ,, left in	5*d.* ,, ,, ,,
Planking and strutting to open excavations	4*d.* to 6*d.* ,, ,, ,,
,, ,, ,, , including shoring, to open excavations ..	8*d.* to 10*d.* ,, ,, ,,

Pumping and Baling

No fixed values can be given for keeping the excavation free from water. When the item is at the risk of the builder, the estimator must rely upon his knowledge of local conditions, or upon observation on the site.

Mechanical Excavation

Mechanical excavation on building sites is, generally speaking, suitable only for large-bulk excavations.

When an output of from 150 to 200 yd. cube per day can be handled, and suitable arrangements made for loading the whole output directly to lorries, the cost of digging and loading can be carried out at from 1*s.* to 1*s.* 3*d.* per yard cube, including all plant charges. To these figures must be added the cost of any trimming required to the sides of the excavation.

Schedule of Prices

The schedule of prices (on page 103) for excavators' work is based upon labourers' wages at 1*s.* 3*d.* per hour and removal of earth at 3*s.* per yard cube.

For each type of soil, column No. 1 gives the net cost prices for the unit item of work, column No. 2 the adjustment figure for each 1*d.* per hour variation on the wages rate, and column No. 3 the adjustment figure for each 1*s.* per yard cube variation on the cost of cartage of the soil.

CONCRETOR

Labour Cost

The labour cost in concreting is regulated chiefly by the speed at which the concrete can be placed in position.

The number of men that can be economically employed in filling and working a concrete mixer, except one of small capacity, may be taken as four. The wages of these men, together with the machine charges, are spread over the output for a given period. If the amount of concrete placed during this period is reduced, owing to the class of concreting being executed, the mixing cost per yard cube will be increased in proportion.

SCHEDULE OF PRICES FOR EXCAVATORS' WORK

(ALL PRICES ARE NET COST)

	Loose Soil			Fairly Hard Soil			Compact Gravel			Clay		
	1	2	3	1	2	3	1	2	3	1	2	3
	s. d.	d.	s. d.	s. d.	d.	s. d.	s. d.	d.	s. d.	s. d.	d.	s. d.
Per yard cube												
Bulk excavation not exceeding 5 ft. deep and throw out	1 3	1	—	2 6	2	—	2 11	2¼	—	3 5	2¾	—
Add for each additional throw of 5 ft...	7½	½	—	9	¾	—	9	¾	—	11¼	¾	—
Trench excavation not exceeding 5 ft. deep and throw out	1 6¾	1¼	—	3 1½	2½	—	3 9	3	—	4 4½	3½	—
Add for each additional throw of 5 ft. ..	9¼	½	—	11¼	¾	—	11¼	¾	—	1 1	1	—
Load vehicles and cart away	4 1	½	1 2	4 6	½	1 3	4 6	½	1 3	5 5	¾	1 6
Wheel 20 yd., load vehicles and cart away	5 0	1¼	1 2	5 6	1½	1 3	5 6	1½	1 3	6 8	1¾	1 6
Wheel, for each additional run of 20 yd.	3¾	¼	—	5	¼	—	5	¼	—	7½	½	—
Fill baskets and remove 20 yd.	1 3	1	—	1 6¾	1¼	—	1 6¾	1¼	—	1 10½	1½	—
Wheel 20 yd. and deposit in bulk in making up ground	1 2¼	1	—	1 3¾	1	—	1 3¾	1	—	1 6¾	1¼	—
Fill and ram to drain, etc., trenches ..	1 8¼	¾	2¼	1 10½	1	2½	1 10½	1	2½	2 4	1¼	3
„ „ „ around footings	2 0	1	2¼	2 5	1½	2½	2 5	1½	2½	2 9½	1¾	3
Per yard super												
Excavate 6 in. deep and throw out ..	5	¼	—	8	½	—	9	½	—	10¾	¾	—
„ 9 in. „ „ „ „ ..	6¼	½	—	10½	¾	—	11¾	¾	—	1 2	1	—
„ 12 in. „ „ „ „ ..	7½	½	—	1 1	1	—	1 2¾	1	—	1 5¼	1¼	—
Spread and level earth 6 in. thick ..	3	¼	—	3	¼	—	3	¼	—	—	—	—
„ „ „ „ 9 in. „ ..	5	¼	—	5	¼	—	5	¼	—	—	—	—
„ „ „ „ 12 in. „ ..	6	½	—	6	½	—	6	½	—	—	—	—

For building work of medium size, a $\frac{1}{4}$-yd. mixed batch capacity mixer is a useful size. A machine of this type would be kept fairly constantly employed, and an output of about 30 yd. cube of mixed concrete per day should be maintained in foundations and concrete over areas, where the total quantity admits of suitable regulation of the labour placing in position.

For heavy foundations, or for other types of work when special placing equipment is available, a mixer of larger capacity would be employed and a saving in the cost of mixing effected.

For small work, the cost of machine mixing will show very little, if any, saving over hand mixing. A mixer would, however, be employed to secure efficiency of the mix.

Mixing Cost per Yard Cube of Concrete

(*a*) *Machine Cost*

The cost of depreciation on a $\frac{1}{4}$-yd. concrete mixer, allowing a useful life of four years, and a yearly output of about 3,000 yd. cube of mixed concrete, amounts to about 3½*d.* per yard cube of concrete. Petrol and lubricating oil will cost about 2*d.* per yard cube.

The transport of mixer to and from the job will probably cost £3, and this charge has to be apportioned over the total number of yards cube of concrete in the work. If the total quantity of concrete is 200 yd., this charge will amount to approximately 3½*d.* per yard cube.

Total machine charges :—

Depreciation	3½*d.*
Petrol and sundries	2*d.*
Transport	3½*d.*
Total per yard of concrete	9*d.*

(*b*) *Labour Cost*

With a daily output of 30 yd. cube of concrete, three men filling and one man operating the mixer, the labour cost in machine mixing will be :—

				£	s.	d.
Labourers, 3 × 8 hours, 24 hours	..	@ 1*s.* 3*d.*		£1	10	0
Man on machine	9 ,,	..	@ 1*s.* 4*d.*		12	0
				30)2	2	0
		Per yard cube, say			1	5

With an output of 40 yd. cube per day, this cost will be reduced to about 1*s.* per yard cube.

Labour for hand mixing, including turning twice dry and twice wet—labourers, 2 hours per yard cube.

Placing Costs

The concrete, after mixing, will normally be filled in a barrow and wheeled to the point of placing. If the mixer can be placed adjacent

to the position for depositing the concrete, and in those cases where the concrete is deposited direct in a hopper for hoisting, the cost of this operation will be omitted.

The following labour values are for work not involving hoisting :—

LABOUR, WHEELING AND PLACING CONCRETE

Per yard cube	*Labourer*
Placing in bulk, direct from mixer, and tamping	1 hour
Wheeling, not exceeding 20 yd., placing in bulk, and tamping	$1\frac{3}{4}$,,
,, ,, ,, ,, ,, and tamping in small foundation trenches	2 ,,
Per yard super	
Extra labour, spreading to areas under 12 in. thick	$\frac{1}{4}$,,
,, ,, tamping around filler joists in floors	$\frac{1}{5}$,,

Hoisting

Hand hoisting will be employed only for work in small quantities. Labour hoisting, $1\frac{1}{2}$ hours per yard cube of concrete for each 10 ft. in height of lift.

With hand hoisting the cost is proportional to the height of lift. The height raised makes little difference in machine hoisting, owing to the speed at which the hoist is operated.

Machine costs for a hoist of 10-cwt. lifting capacity :—

Depreciation	3*d.*
Delivery and erection of hoist	4*d.*
Petrol and sundries	3*d.*
Total per yard cube of concrete	10*d.*

With an output of 20 yd. of concrete placed per day, the manual cost of operating the hoist will be about 1*s.* per yard cube, allowing for the attendance of two labourers.

For hoisting up to, say, 40 ft. in height, the total cost of machine hoisting will be 1*s.* plus 10*d.* = 1*s.* 10*d.* per yard cube.

For large contracts, the erection, maintenance, and depreciation of cranes are more conveniently charged as a special plant item in the preliminary bill, and not directly charged to the individual unit items.

Materials for Concrete

The consolidation of materials in making and placing concrete varies with the type and size of the aggregate used.

In concrete made with ungraded aggregates (pit or river ballast with its natural proportion of sand) the cement fills the voids in the ballast and does not normally add to the total bulk. The shrinkage of ballast of this type is one-sixth of its bulk.

When ballast and sand are mixed in defined proportions, i.e. graded aggregates, the total shrinkage from bulk (cement, sand, and ballast separately measured) is approximately 33 per cent., varying slightly with the size of the aggregate.

MATERIALS PER YARD CUBE OF CONCRETE

	Cement lb.	*Sand (cu. ft.)*	*Ballast (cu. ft.)*
Ungraded aggregates			
1 part of Portland cement to 4 parts of ballast ..	730	—	$32\frac{1}{2}$
1 ,, ,, ,, 6 ,, ,, ...	490	—	$32\frac{1}{2}$
1 ,, ,, ,, 8 ,, ,, ...	365	—	$32\frac{1}{2}$
1 ,, ,, ,, 10 ,, ,, ...	290	—	$32\frac{1}{2}$
Graded aggregates (1-in. clean aggregate)			
1 part cement, 3 parts sand, 6 parts ballast	360	12	24
1 ,, ,, 2 ,, ,, 4 ,, ,, ...	520	$11\frac{1}{2}$	23
1 ,, ,, $1\frac{1}{2}$,, ,, 3 ,, ,, ...	660	11	22

A practical method of pricing the aggregates for concrete is given in the detailed price analyses.

Examples of Detailed Price Analysis

Based upon machine mixing, output 30 yd. cube per day.

(7) 1 : 6 *Portland cement concrete in foundations.*

		£	s.	d.
490 lb. Portland cement	@ 39*s.* per ton ..		8	6
$32\frac{1}{2}$ cu. ft. Thames ballast	@ 7*s.* per yard ..		8	5
Machine cost in mixing	.. .. ..			9
Labour cost in mixing	.. .. ..		1	5
Labour wheeling, placing, and tamping in bulk, labourer, $1\frac{3}{4}$ hours	@ 1*s.* 3*d.* ..		2	2
	Per yard cube, net	£1	1	3

(8) *Alternative method for concretes with ungraded ballast.*
1 : 6 *Portland cement concrete in foundations.*

		£	s.	d.
1 yd. cube Portland cement, $1\frac{1}{11}$ tons (based on 90 lb. per foot cube)	@ 39*s.* per ton ..	2	2	6
6 yards Thames ballast	@ 7*s.* per yard..	2	2	0
		4	4	6
Add $\frac{1}{5}$ to provide $\frac{1}{6}$ shrinkage on ballast			16	11
Divide by number of parts of ballast in mix		6)5	1	5
			16	11
Add mixing and placing costs, as Example No. 7			4	4
	Per yard cube, net	£1	1	3

(9) 1 : 2 : 4 *Portland cement concrete in foundations.*

		£	s.	d.
520 lb. Portland cement	@ 39*s.* per ton ..		9	0
$11\frac{1}{2}$ cu. ft. sand	@ 7*s.* per yard..		3	0
23 cu. ft. 1-in. washed ballast	@ 6*s.* per yard..		5	1
Mixing and placing costs, as Example No. 7 ..	.. .. ..		4	4
	Per yard cube, net	£1	1	5

(10) *Alternative method for concretes with graded aggregate.*
1 : 2 : 4 *Portland cement concrete in foundations.*

		£	s.	d.
1 yd. cube Portland cement, $1\frac{1}{11}$ tons	@ 39*s.* per ton ..	2	2	6
2 yd. cube sand	@ 7*s.* per yard..		14	0
4 yd. cube 1-in. washed ballast	@ 6*s.* per yard..	1	4	0
		4	0	6
Add to net quantity 50 per cent. to provide 33 per cent. shrinkage from bulk		2	0	3
Divide by total parts in mix = 1 + 2 + 4 = ...	7)	6	0	9
			17	3
Mixing and placing costs, as Example No. 7 ..	.. .. ..		4	4
	Per yard cube, net	£1	1	7

(11) 1 : 2 : 4 *Portland cement concrete* 9 *in. thick, spread and levelled.*

Per yard cube

		£	s.	d.
Materials, as Example No. 10			17	3
Mixing and placing in bulk			4	4
	Basis price	£1	1	7

Per yard super

		£	s.	d.
9)36 in. = $\frac{1}{4}$ yd. cube concrete	@ 21*s.* 7*d.* ..		5	$4\frac{3}{4}$
Extra labour for thickness of 12 in. and under, labourer, $\frac{1}{4}$ hour	@ 1*s.* 3*d.* ..			$3\frac{3}{4}$
	Per yard super 9 in. thick, net		5	$8\frac{1}{2}$

(12) 1 : 2 : 4 *Portland cement concrete* 6 *in. thick, hoisted* 40 *ft. above ground, and tamped around filler joists.*

Per yard cube

		£	s.	d.
Materials, as Example No. 10			17	3
Mixing and placing in bulk			4	4
Machine hoisting on basis of 20 yd. cube placed per day			1	10
	Basis price	£1	3	5

Per yard super

		£	s.	d.
6)36 in. = $\frac{1}{6}$ yd. cube concrete	@ 23*s.* 5*d.* ..		3	11
Extra labour for thicknesses of 12 in. and under, labourer, $\frac{1}{4}$ hour	@ 1*s.* 3*d.* ..			$3\frac{3}{4}$
Extra labour for tamping around sections in floor, labourer, $\frac{1}{5}$ hour	@ 1*s.* 3*d.* ..			3
	Per yard super 6 in. thick, net		4	$5\frac{3}{4}$

Schedule of Prices

The basis prices given in the Schedules are calculated upon the following cost prices :—

Labourer	.. ..	1*s.* 3*d.* per hour
Portland cement	..	39*s.* per ton
Ballast ..	.. ..	6*s.* per yard cube
Sand ..	.. ..	7*s.* ,, ,, ,,

Schedule No. 1.—Ungraded aggregates.

Column 1. Basis price of concrete per yard cube.
,, 2. Variation in price per yard of concrete for each 1*s.* per yard cube in price of ballast.
,, 3. Variation in price per yard of concrete for each 1*s.* per ton in price of Portland cement.
,, 4. Variation in price per yard of concrete for each 1*d.* per hour in labourers' wages.

Schedule No. 2.—Graded aggregates.

Column 1. Basis price of concrete per yard cube.
,, 2. Variation for each 1*s.* per yard cube in price of ballast.
,, 3. ,, ,, ,, 1*s.* ,, ,, ,, ,, sand.
,, 4. ,, ,, ,, 1*s.* ,, ton in price of Portland cement.
,, 5. ,, ,, ,, 1*d.* ,, hour in labourers' wages.

SCHEDULES OF NET COST PRICES FOR CONCRETE

No. 1.—Ungraded Aggregate

Machine Mixed	1 : 4 *Mix*						1 : 6 *Mix*					
	1		2		3	4	1		2		3	4
	s.	*d.*	*s.*	*d.*	*d.*	*d.*	*s.*	*d.*	*s.*	*d.*	*d.*	*d.*
Concrete placed direct from mixer												
Per yard cube												
Portland cement concrete in bulk ..	24	7	1	2½	4	3	20	4	1	2½	2½	3
Ditto in small foundation trenches	25	7	1	2½	4	3¾	21	4	1	2½	2½	3¾
Per yard super												
Portland cement concrete spread and levelled, 4 in. thick	3	0¾		1⅝	½	⅝	2	6¾		1⅝	¼	⅝
Ditto 6 in. thick	4	4¾		2⅜	⅝	¾	3	8½		2⅜	⅜	¾
Ditto 9 in. thick	6	5¾		3⅝	1	1	5	4¾		3⅝	⅝	1
Ditto 12 in. thick	8	5¾		4⅞	1⅜	1¼	7	1¼		4⅞	¾	1¼
Concrete, including wheeling 20 yd. and placing												
Per yard cube												
Portland cement concrete in bulk ..	25	6	1	2½	4	3¾	21	3	1	2½	2½	3¾
Ditto in small foundation trenches	26	6	1	2½	4	4½	22	3	1	2½	2½	4½
Per yard super												
Portland cement concrete spread and levelled, 4 in. thick	3	1¾		1⅝	½	¾	2	8		1⅝	¼	¾
Ditto 6 in. thick	4	6¾		2⅜	⅝	⅞	3	10¼		2⅜	⅜	⅞
Ditto 9 in. thick	6	8¼		3⅝	1	1⅛	5	7½		3⅝	⅝	1⅛
Ditto 12 in. thick	8	9¾		4⅞	1⅜	1½	7	4¾		4⅞	¾	1½

No. 2.—Graded Aggregate

Machine Mixed	1 : 3 : 6 *Mix*						1 : 2 : 4 *Mix*					
	1		2	3	4	5	1		2	3	4	5
	s.	*d.*	*d.*	*d.*	*d.*	*d.*	*s.*	*d.*	*d.*	*d.*	*d.*	*d.*
Concrete placed direct from mixer												
Per yard cube												
Portland cement concrete in bulk ..	18	2	10½	5¼	2	3	20	6	10¼	5⅛	2¾	3
Ditto in small foundation trenches	19	2	10½	5¼	2	3¾	21	6	10¼	5⅛	2¾	3¾
Per yard super												
Portland cement concrete spread and levelled 4 in. thick	2	4	1¼	⅝	¼	⅝	2	7¼	1⅛	⅝	⅜	⅝
Ditto 6 in. thick	3	4	1⅞	1	⅜	¾	3	8¾	1¾	⅞	½	¾
Ditto 9 in. thick	4	10¼	2⅝	1⅜	½	1	5	5¼	2½	1¼	¾	1
Ditto 12 in. thick	6	4½	3½	1¾	¾	1¼	7	1¾	3⅜	1⅝	⅞	1¼
Concrete, including wheeling 20 yd. and placing												
Per yard cube												
Portland cement concrete in bulk ..	19	1	10½	5¼	2	3¾	21	5	10¼	5⅛	2¾	3¾
Ditto in small foundation trenches	20	1	10½	5¼	2	4½	22	5	10¼	5⅛	2¾	4½
Per yard super												
Portland cement concrete spread and levelled 4 in. thick	2	5¼	1¼	⅝	¼	¾	2	8¼	1⅛	⅝	⅜	¾
Ditto 6 in. thick	3	6	1⅞	1	⅜	⅞	3	10¾	1¾	⅞	½	⅞
Ditto 9 in. thick	5	1	2⅝	1¾	½	1⅛	5	8	2½	1¼	¾	1⅛
Ditto 12 in. thick	6	8	3½	1¾	¾	1½	7	5¾	3⅜	1⅝	⅞	1½
Floors 6 in. thick, tamped around steel sections												
Including power hoisting up to 40 ft. in height	—		—	—	—	—	4	5¾	1¾	⅞	½	1¼
Ditto hand hoisting 20 ft. in height	—		—	—	—	—	4	11¼	1¾	⅞	½	1¾
Ditto hand hoisting 40 ft. in height	—		—	—	—	—	5	4¾	1¾	⅞	½	2⅜

DRAINLAYER

Trench Excavation

The work involved in excavation to trenches comprises "Excavate to trench and throw out, trim earth at side of trench, return and ram earth and cart away surplus."

In addition to the labour values given under Excavator, an additional ¼ hour per yard cube should be provided for trimming the earth at the side of trench.

The amount of surplus earth to be removed will vary with the depth of trench and the space occupied by the drain pipe and bed. When the drain pipes do not exceed 6-in. diameter, allow for removing one-fifth yard cube of surplus earth to each yard cube of excavation for trenches not exceeding 5 ft. deep, and one-sixth yard cube for deeper trenches.

For deep trenches, with several frames of close-boarded planking and strutting, some addition to the normal width of trench should be provided.

Basis price of Excavation (Fairly hard soil).

(13) *Excavate to drain trench not exceeding 5 ft. deep, return and ram earth and cart surplus.*

Excavate and throw out	$2\frac{1}{2}$ hours
Trim earth	$\frac{1}{4}$ hour
Return and ram earth	$\frac{9}{10}$,,
Total, say	$3\frac{3}{5}$ hours

		s.	d.
Labourer, $3\frac{3}{5}$ hours	@ 1*s.* 3*d.*	4	6
Cart surplus, $\frac{1}{5}$ yd. cube (see Example No. 4)	@ 5*s.* 6*d.*	1	1
Per yard cube, net		5	7

(In this example it is assumed that the total depth of excavation does not exceed 5 ft.)

(14) *Excavate to drain trench exceeding* 5 *ft. and not exceeding* 10 *ft. deep, return and ram and cart surplus.*

Excavate not exceeding 5 ft. deep and throw out	$2\frac{1}{2}$ hours
One additional throw	$\frac{3}{4}$ hour
Trim earth	$\frac{1}{4}$,,
Return and ram	$\frac{9}{10}$,,
Total, say	$4\frac{2}{5}$ hours

		s.	d.
Labourer, $4\frac{2}{5}$ hours	@ 1*s.* 3*d.*	5	6
Allowance for staging	.. ..		3
Cart surplus, $\frac{1}{6}$ yd. cube	@ 5*s.* 6*d.*		11
Per yard cube, net		6	8

Tabulated Values

The Table on page 111 gives the complete values for excavation to drain trenches of various widths and depths in "fairly hard soil." Column No. 1 gives the cost based on labourers' rate at 1*s.* 3*d.* per hour, and column No. 2 the adjustment for each 1*d.* per hour on the wages rate. Planking and strutting values are given in the adjoining columns.

Concrete Beds for Drains

The concrete used for beds under drains will normally be hand mixed and composed of one part of Portland cement to six parts of ungraded ballast. The work will be in comparatively small quantities, and a total time allowance for mixing and placing of 5 hours per yard cube should be provided.

When the concrete is benched half-way up the sides of the pipe, an additional cost value of 1*d.* per foot run for pipes up to 6-in. diameter,

EXCAVATION TO DRAIN TRENCHES (Fairly Hard Soil)

NET COST per Foot Run of Trench

Depth of Trench		*Trench 1 ft. 9 in. wide*		*Trench 2 ft. wide*		*Trench 2 ft. 6 in. wide*		*Plank and Strut*	
		1	2	1	2	1	2	*Basis 1d. per foot super*	*Basis 2½d. per foot super*
ft.	*in.*	*s. d.*	*d.*	*s. d.*	*d.*	*s. d.*	*d.*	*s. d.*	*s. d.*
1	6	6½	⅜	7¼	½	9	⅝	3	7½
2	0	8½	½	9½	⅝	1 0	¾	4	10
2	6	10½	⅝	1 0	¾	1 3	1	5	1 0½
3	0	1 0½	¾	1 2¼	⅞	1 6	1⅛	6	1 3
3	6	1 2½	⅞	1 4½	1	1 9	1¼	7	1 5½
4	0	1 4½	1	1 7	1⅛	2 0	1½	8	1 8
4	6	1 6¾	1⅛	1 9½	1¼	2 3	1¾	9	1 10½
5	0	1 9	1¼	2 0	1½	2 6	2	10	2 1
5	6	—	—	2 4½	1⅞	3 0	2½	11	2 3½
6	0	—	—	2 9¼	2¼	3 6	3⅛	1 0	2 6
6	6	—	—	3 0⅜	2⅜	3 9½	3¼	—	2 8½
7	0	—	—	3 3½	2½	4 1	3⅜	—	2 11
7	6	—	—	3 6¼	2¾	4 4½	3½	—	3 1½
8	0	—	—	3 9	2⅞	4 8	3⅝	—	3 4
8	6	—	—	3 11¾	3	4 11½	3¾	—	3 6½
9	0	—	—	4 2½	3¼	5 3	4	—	3 9
9	6	—	—	4 5½	3½	5 6¾	4¼	—	3 11½
10	0	—	—	4 8½	3¾	5 10½	4½	—	4 2
10	6	—	—	—	—	6 9¼	5⅛	—	4 4½
11	0	—	—	—	—	7 8	5⅝	—	4 7
11	6	—	—	—	—	8 0	5⅞	—	4 9½
12	0	—	—	—	—	8 4	6⅛	—	5 0
12	6	—	—	—	—	8 8	6⅜	—	5 2½
13	0	—	—	—	—	9 0	6⅝	—	5 5
13	6	—	—	—	—	9 4¼	6⅞	—	5 7½
14	0	—	—	—	—	9 8½	7⅛	—	5 10
14	6	—	—	—	—	10 0¾	7⅜	—	6 0½
15	0	—	—	—	—	10 5	7⅝	—	6 3

and 1½*d.* per foot run for pipes above 6-in. up to 12-in. diameter, should be provided for the extra labour and cement. To provide for the extra amount of concrete in benching, the following allowances to the thickness of the concrete should be made :—

4-in. diameter pipe		..	..	1 in.
6-in.	,, ,,	..	..	1½ in.
9-in.	,, ,,	..	..	2 in.
12-in.	,, ,,	..	..	2½ in.

For example, a concrete bed, 6 in. thick and 1 ft. 9 in. wide, for a 9-in. diameter pipe, including benching to sides of pipe ; the equivalent size of bed would be 1 ft. 9 in. wide and 8 in. thick.

Basis Price of Concrete for Drain Beds.

(15) 1 : 6 *Portland cement concrete.*

		£	s.	d.
1 yd. cube Portland cement	@ 39*s.* per ton	2	2	6
6 yd. Thames ballast	@ 7*s.* per yard	2	2	0
		4	4	6
Add shrinkage allowance $\frac{1}{5}$			16	11
		6)5	1	5
Materials per yard cube			16	11
Labourer, 5 hours	@ 1*s.* 3*d.* ..		6	3
	Per yard cube, net	£1	3	2

(16) *Concrete bed for* 9-*in. diameter pipe,* 1 *ft.* 9 *in. wide and* 6 *in. thick, including benching half-way up sides of pipe, and neatly flaunching.*

			s.	d.
1 ft. 0 in. 1 ft. 9 in. 6 in.	0 . 10 . 6.	Portland cement concrete (bed).		
1 ft. 0 in. 1 ft. 9 in. 2 in.	0 . 3 . 6.	„ „ „ (benching).		
	1 . 2 . 0.	.. .. .. @ 23*s.* 2*d.* per yard cube		11$\frac{3}{4}$
	Extra labour and cement benching and flaunching concrete to sides of pipe			1$\frac{1}{2}$
		Per foot run, net	1	1$\frac{1}{4}$

Tabulated Values

1 : 6 PORTLAND CEMENT CONCRETE BEDS FOR DRAINS

Based upon concrete at 23*s.* per yard cube laid in drain beds. Extra labour in benching to sides of pipe must be added.

Sectional Area of Concrete	*Net Cost per Foot Run*	*Sectional Area of Concrete*	*Net Cost per Foot Run*
sq. in.	*d.*	*sq. in.*	*s. d.*
72	5$\frac{1}{4}$	162	11$\frac{3}{8}$
78	5$\frac{3}{4}$	168	11$\frac{3}{4}$
84	6$\frac{1}{4}$	174	1 0$\frac{1}{8}$
90	6$\frac{3}{4}$	180	1 0$\frac{5}{8}$
96	7$\frac{1}{4}$	186	1 1
102	7$\frac{5}{8}$	192	1 1$\frac{3}{8}$
108	8	198	1 1$\frac{3}{4}$
114	8$\frac{3}{8}$	204	1 2$\frac{1}{8}$
120	8$\frac{3}{4}$	210	1 2$\frac{1}{2}$
126	9$\frac{1}{8}$	216	1 3
132	9$\frac{1}{2}$	222	1 3$\frac{1}{2}$
138	9$\frac{7}{8}$	228	1 4
144	10$\frac{1}{4}$	234	1 4$\frac{1}{2}$
150	10$\frac{5}{8}$	240	1 5
156	11	246	1 5$\frac{1}{2}$

For each 1*s.* per yard cube difference in the price of concrete, add $\frac{1}{23}$ to the figures tabulated.

CINEMA PLANNING

THE object of this article is to illustrate from an actual example of to-day's cinema practice the principal items of interest in planning.

The theatre is one seating 2,500, with " cine-variety " stage accommodation only—characteristic of the type being erected in the foremost provincial cities.

In this case there were no especially exacting by-laws, hence the planning generally possesses no exceptional feature, and may be taken as normal for a house of this size. The site possesses a wide frontage to an important street, but the rear is surrounded with old factory buildings invisible from the front. The building is fully steel-framed on Franki concrete piles.

Entrance Hall

Noticeable is the absence of the " grand staircase," very much featured in old-fashioned theatres. To-day, high site values demand maximum accommodation, simplicity of management arrangements, and purely practical accessories. Easy circulation and the avoidance of crossing queues from street to seat are essential.

Two separate staircases are provided from the rear of the balcony, one from the lower balcony level and another from the café—there is also a pass from the café to the lower balcony stairs. Regulations demand that staircases be enclosed within fire-resisting walls.

The stalls and balcony pay-boxes are separated by a chocolate kiosk. Where space permits, a combined central pay-box has its advantages, especially for smaller theatres, but managers have conflicting views on this point.

Draught lobbies are essential. The plans show a manager's office conveniently situated with access into the vestibule and into the auditorium. A small cloakroom is very useful—mostly for parcels.

The lavatories are approached through ventilated lobbies direct from the auditorium. It is not desirable that they should have other access.

Front Stalls

An additional pay-box is provided ; this is commonly called for in provincial and suburban halls.

The orchestra pit contains a 10-ft. by 6-ft. organ console platform, electrically operated from a motor under. The steps at each side of the stage are more ornamental than useful. A projecting bay in the orchestra

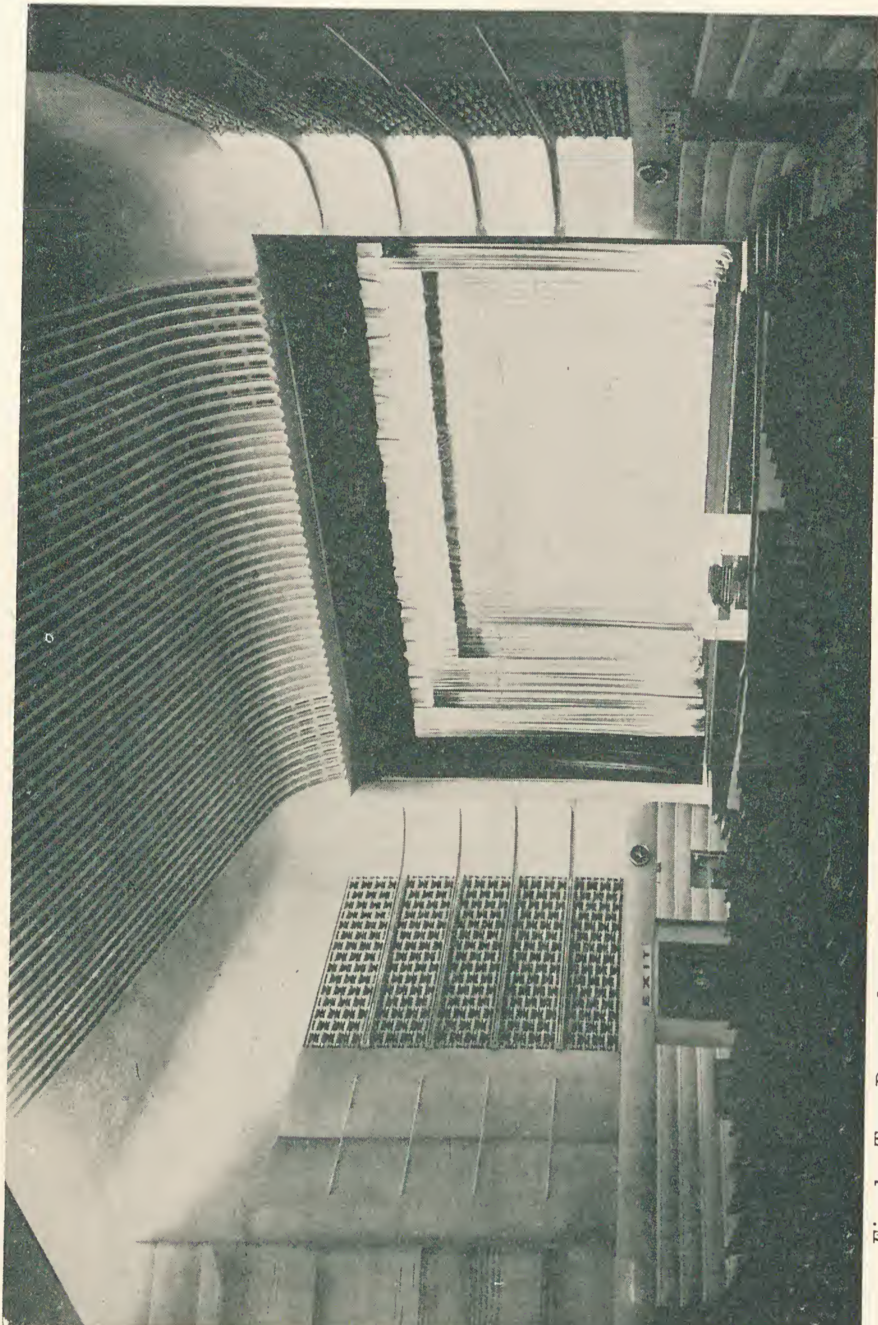


Fig. 1.—The Plaza, Sutton, a modern cinema with stage accommodation, seating 2,500 people
(*Architect: Robert Cromie, F.R.I.B.A.*)

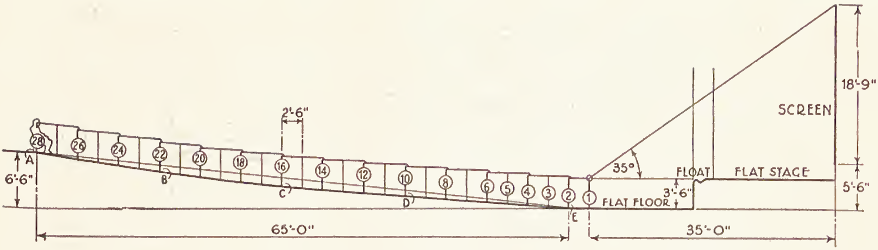


Fig. 2.—How to set out correctly a parabolic floor

well provides space for the musical director and his rostrum for use when the organ is played with an orchestra. The level of the orchestra floor is often a matter dependent upon the kind of performance. There is a tendency to show rather than to hide the modern cinema orchestra.

The front seats are set out at 2 ft. 5 in. back to back, although 2 ft. 4 in. is still quite common practice for the cheapest seats in the house, i.e. the front rows. The actual allocation of prices is a matter for the management to decide.

Stalls Floor

The stalls floor is laid at a rake of 1 in 10 from a point 38 ft. in front of curtain line. This arrangement is generally satisfactory, but it must be noted that the floor is naturally dished, that is, it is segmental on cross-section, so that each concentric row maintains its level. In cases where the seats are at right angles to the centre line, the floor would slope normally.

Fig. 2 shows how to set out correctly a parabolic floor especially required for stage shows. The eye-line is 3 ft. 6 in. above floor, and the sight is taken over 3 ft. 10 in. (top of head) at every *second* row.

In actual practice the obstruction of a small portion of the *stage* view by heads in the foremost rows is not very noticeable—whereas when the picture screen is concerned there must never be any portion of it obscured.

Where standing is allowed, the sight-line should be taken at 5 ft. 3 in. from rear stalls barrier to clear soffit of balcony front, allowing a 2-ft. clearance margin above top of picture.

Spacing of Seats

Note that all gangways have parallel sides. This is achieved by fractional differences in the widths of the seats, which are 20 in. nominal from centre to centre of arm-pads. Allow extra gangway width for the end half arm-pads.

Extra seating accommodation can usually be obtained by placing short rows against the side walls, in which case the number should not be more than six—odd numbers of seats are not desirable.

The spacing of the rear stalls seats is 2 ft. 6 in. back to back, and

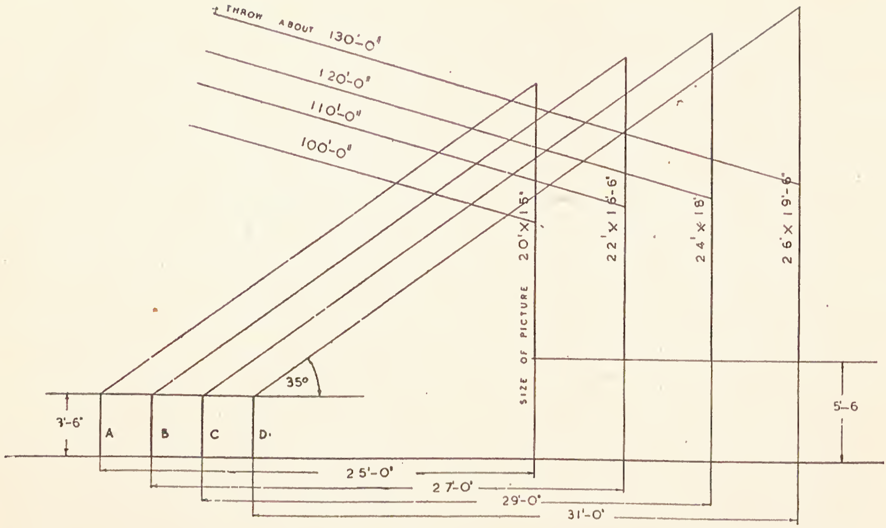


Fig. 3.—SIZE OF PICTURE AND DISTANCE FROM FRONT ROW
Showing normal setting out of screen on centre line for various lengths of throw.

attention is drawn to the comparison of stalls and balcony spacings—the latter must always be more on account of the seat-back overhang at knee height.

Orchestra rail—this should be 2 ft. 6 in. high, either solid or open, and sufficiently far from the front seats to prevent its being kicked. The rear barrier is 4 ft. high.

Access to orchestra pit should be from both sides of, and underneath, the stage.

Distance of Front Seats from Screen

There is often a doubt—especially in the smaller cinemas—as to the necessity of providing a stage. But the distance from the front seats to the screen is arrived at by a 35° angle taken from the front row eye-line (3 ft. 6 in.) to the top of the picture, and this always leaves sufficient space for at least a small stage. The bottom of the picture is approximately 5 ft. 6 in. to 6 ft. above stalls level : its height is three-quarters of the width. Fig. 3 shows normal screen (i.e. *picture*) sizes. There should be a space of not less than 5 ft. behind the screen. Where it is proposed to construct a recess, this must be at least 12 ft. wide, and should extend from the top of the picture down to stage level.

Café

The café normally occupies the void under the balcony. When the latter is served by a central " vomitory " (or entrance *through* it) a con-

venient space becomes available for the kitchen service. Note that servery doors are best far apart, that ample ventilated store room is provided, and a kitchen-staff lavatory—also goods lift and external stairs. A small office for the manageress is essential. Lavatories are required at this level for both the café and front balcony. These should have hot water. The plans illustrated show an additional snack-bar, which is not usual.

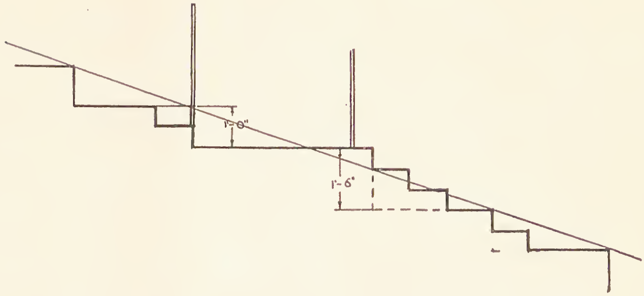


Fig. 4.—Improved arrangement for balcony seats

Lower Balcony Level

This balcony has five 3-ft. rows below the cross-over gangway. The barrier rail is set back 5 in. to allow for the overhang of the rear seats. This barrier is 3 ft. 9 in. high.

The cross-over gangway should be not less than 3 ft. 6 in. wide between barriers.

For the latest L.C.C. practice see Fig. 4.

The entrance to the best part of the house is through a foyer with doors at both ends to minimise noise, draught, and light.

The balcony front is struck from the same centre as the stalls, and, therefore, an equal sight-line from rear stalls to top of picture is maintained.

The plasterwork to the front is given a short-radius curve, so that it dies away into the side walls.

The plan shows an electrician's gallery for switch-board and spot-light on the prompt side, and a spot-light perch on the O.P. side. As there is no grid, and the screen is, therefore, a fixture, the sound horns are housed in a chamber allowing a total depth of 6 ft. 6 in. Four dressing-rooms are provided, with lavatories.

Balcony Plan (Fig. 8)

This shows the full area of the balcony. The steppings for the front rows are 3 ft. and the rear 2 ft. 9 in.—the rear step being

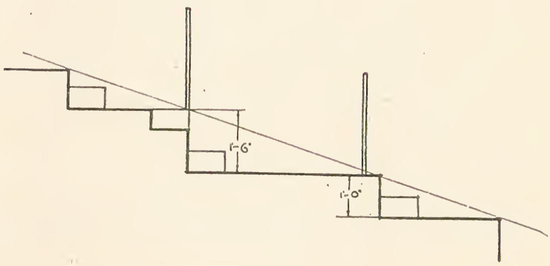


Fig. 5.—Usual arrangement for balcony seats

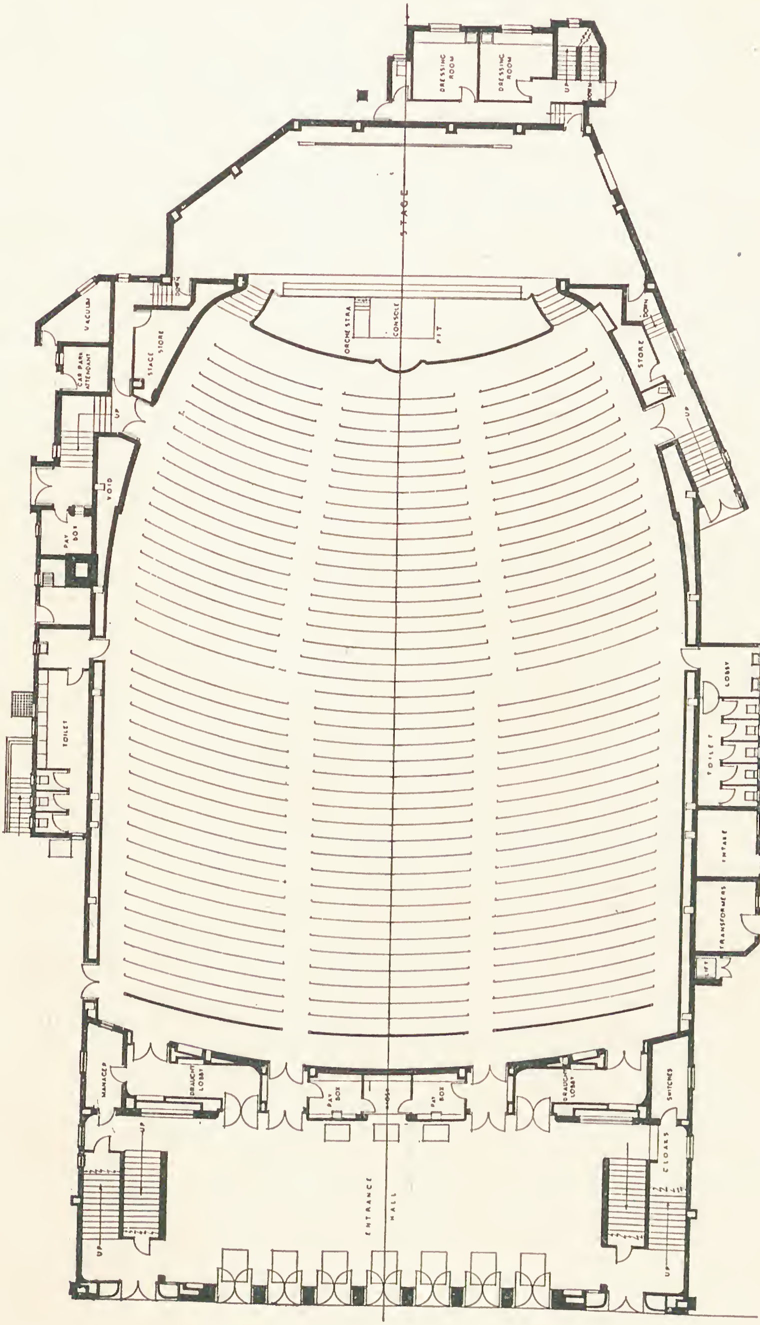


Fig. 6.—STALLS PLAN

3 ft. 5 in. to barrier. Exits are well placed from the rear. The staff rooms are accessible from the stairs, also the projection department.

Balcony sight-lines should be taken from 3 ft. 6 in. at the rear over the balcony front (say 2 ft. 9 in. high) to the bottom of the orchestra rail. The cross-over gangway barrier will always come within this limit.

Stage

When acting as consultant, the writer often has to alter the stage. The usual mistakes are :—

Excessive height above floor ; sloping ; insufficient wing room.

The stage fascia top should be 3 ft. 3 in. above the lowest level of stalls floor, which allows a further 3 in. for the projecting top of the " float " (or foot-lights). Except in certain cases, all stages should be flat. Wing room should be " as much as possible," unless stage shows are not intended. Obviously wing room must be in proportion to the dressing-room accommodation. Provide a property entrance, with roller shutter, say, 10 ft. high by 6 ft. 6 in. wide.

Types of Stage

There are three types of stage :—

(1) Cinema stage—a mere platform.

(2) Cine-variety stage (as illustrated).

(3) Theatre stage, with full grid, counterweights, fireproof curtain, dressing-rooms, etc. etc.

Scenery cannot be used without a stage-play licence. A cine-variety stage requires, say, two to five dressing-rooms, two lavatories, organist's room, music store, etc. But where a full stage show is contemplated, an entirely different problem presents itself. Then the stage should be made as wide and deep as possible, with basement and the accessory accommodation very greatly increased. The clear height to the *roof* is dependent upon the proscenium opening. This is arranged easily to clear the *sight*-line from the projection *observation* port, taken at 5 ft. 3 in. at a distance of 6 ft. back from the port.

Twice the height of the opening plus 8 ft. will suffice where the fireproof curtain is up to 50 ft. wide.

Fireproof Curtain and Counterweights

The fireproof curtain, counterweighted in guides, and hoisted (by electric motor), is entirely independent of the grid. The grid is an open steel floor suspended from the stage roof. This is slung so as to allow about 5 ft. head-room beneath the roof girders. It is constructed of 3 in. inverted channel sections 3 in. apart.

The counterweights are carried in guides on the O.P. wall, and require a space of about 2 ft. (projection) at stage level for the whole width of the stage working area.

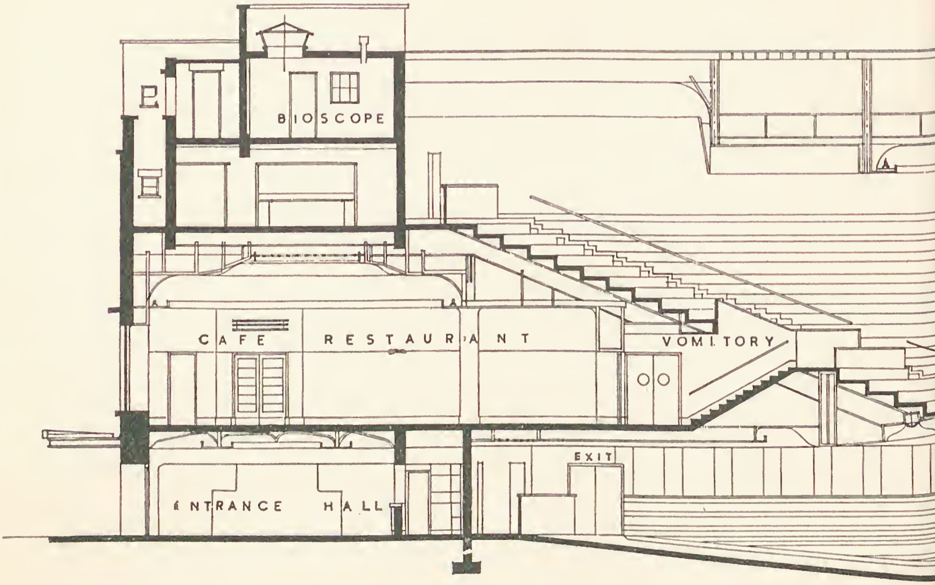


Fig. 7.-

A gallery is suspended from the grid at this side about 2 ft. 6 in. wide, for loading the weights and balancing the sets—as well as the screen, horns, lighting battens, borders, etc. etc.—any of which can be instantly raised out of sight.

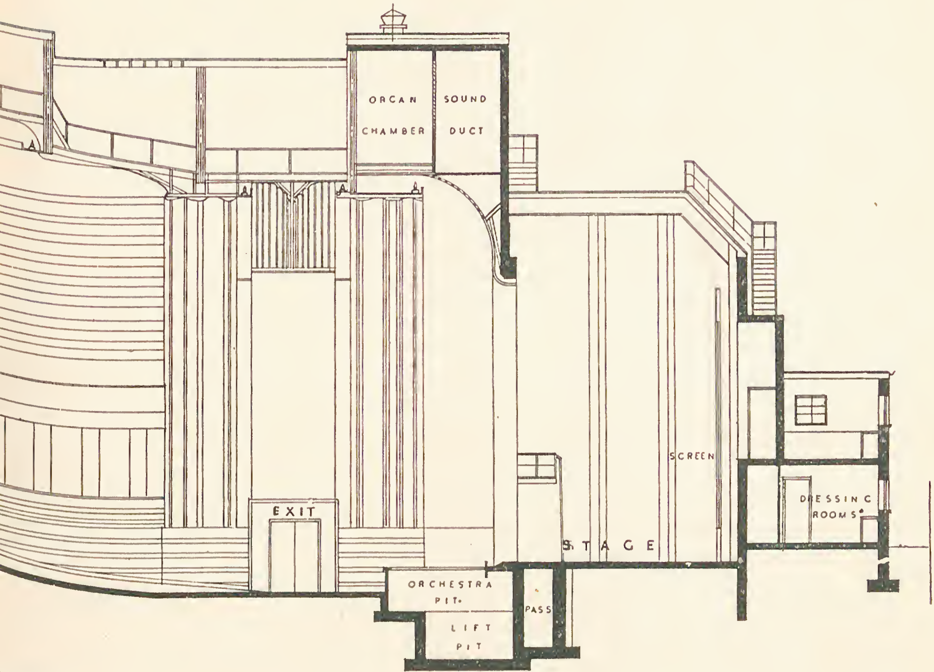
The " Lantern "

The by-laws require a " lantern " of one-sixth the area of the stage where any scenery is used. This is of the automatically opening haystack pattern glazed with thin glass painted black. It is intended to open by the fusing of a soft-metal chain link as well as by hand release from the stage.

The Upper Void

The upper void of a high stage requires heating pipes to avoid the cold-air down draught to front stalls seats when the tableau curtains are opened.

The size and height of this part of the theatre call for steel framing. It is, therefore, obviously fallacious for owners (more acquainted with cinema than theatre requirements) to imagine that a full stage can be grafted on " later if required." But provision can sometimes be made



SECTION

for this in advance—but only by designing the complete stage, together with all its ancillary adjuncts, and then by a process of deletion reducing the scheme on paper to the immediate lesser requirements. The steel-work can be put in ready to receive further extension. The extra cost of this preparatory work might be in the neighbourhood of £1,000, whereas the complete stage, etc., would probably cost a further £1,500.

Needless to add, provision must be made for increasing the electrical and heating installations.

The Organ Chambers

There are three possible positions for the organ chambers: (*a*) at side of proscenium ; (*b*) under the stage ; (*c*) over the proscenium.

The best is probably under the stage, with grilles in the sub-stage auditorium wall, but this is not suitable for a full theatre.

Next best is longitudinal chambers in the ceiling, with sound ducts over the proscenium ; and the third is that commonly adopted, e.g. behind ante-proscenium grilles on one side with "repeater" opposite. The location of the organ chambers is often involved with plenum ducts, lighting coves, and ventilation. Chambers should be planned in conjunction with the organ builders. Their floors should be concrete, with $1\frac{1}{4}$-in. tongued and

grooved floorboards; partition walls should be $4\frac{1}{2}$ in., and outer walls not less than 9 in.—all walls and ceilings rendered Keen's cement and *not* painted or distempered. No windows are required; doors should be 2-in. teak, self-closing; self-opening lanterns 18 in. by 18 in. are required by most authorities. Each chamber should be heated electrically and controlled thermostatically. Blower chambers should be treated similarly.

Heating and Ventilation

The so-called "plenum" system is a *sine qua non.* The problem of heating resolves itself into a matter of running costs. In order of cheapness :—

(1) Coke-fired boilers—hand stoked. Usually used in small cinemas, say up to 750 seats. Operated by a man whose employment is necessary for other services, and whose salary is not chargeable against the plant.

(2) Automatically fired—small "anthracite," gravity fed by self-stoking hoppers. Boiler should be housed under fuel chamber.

(3) Automatically fired by mechanical stoker requiring intelligent, but not continuous, supervision.

(4) Oil-fired—fully automatic, electrically operated.

(5) Electric; thermal storage, current being absorbed at cheaper rates during off-peak hours. Expensive to instal.

(6) Gas.
(7) Electric direct.
} Usually uneconomical, but offer advantages in case of building difficulties.

With regard to ventilation, this can be carried out in various degrees of perfection according to the capital outlay available, and the requirements of the local authorities. It is not necessary to adopt air-refrigeration in this country.

Publicity

Uninformed criticism is often directed to the architect's inability to incorporate publicity in the design of the façade. In actual practice, virtually the whole of the ground-floor level of the front is occupied by doors—hence attention is concentrated upon the canopy. This is detrimental to canopy design, but is unavoidable. There is little tendency to-day to incorporate huge posters above canopy level.

Canopy

There are three outstanding desiderata :—

(1) Canopy *should* be brilliantly illuminated underneath.

(2) The fascia *should* have well-lighted and easily removable letters.

(3) The top *should* be solidly constructed, to carry workmen and window cleaners, and designed to hide the flood-lamps.

Canopies should be as simple as possible in design, and finished so as to require the minimum of upkeep—hence chromium plating, etc., should

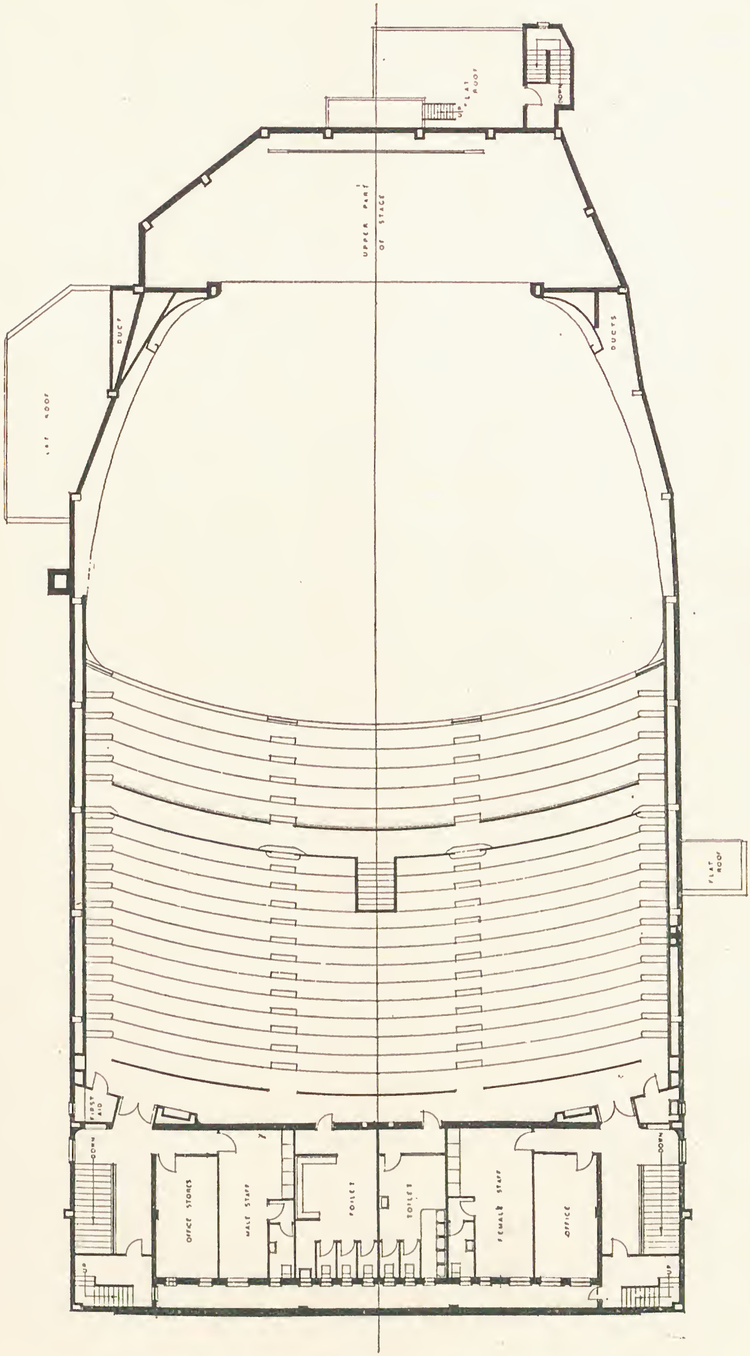


Fig. 8.—BALCONY PLAN

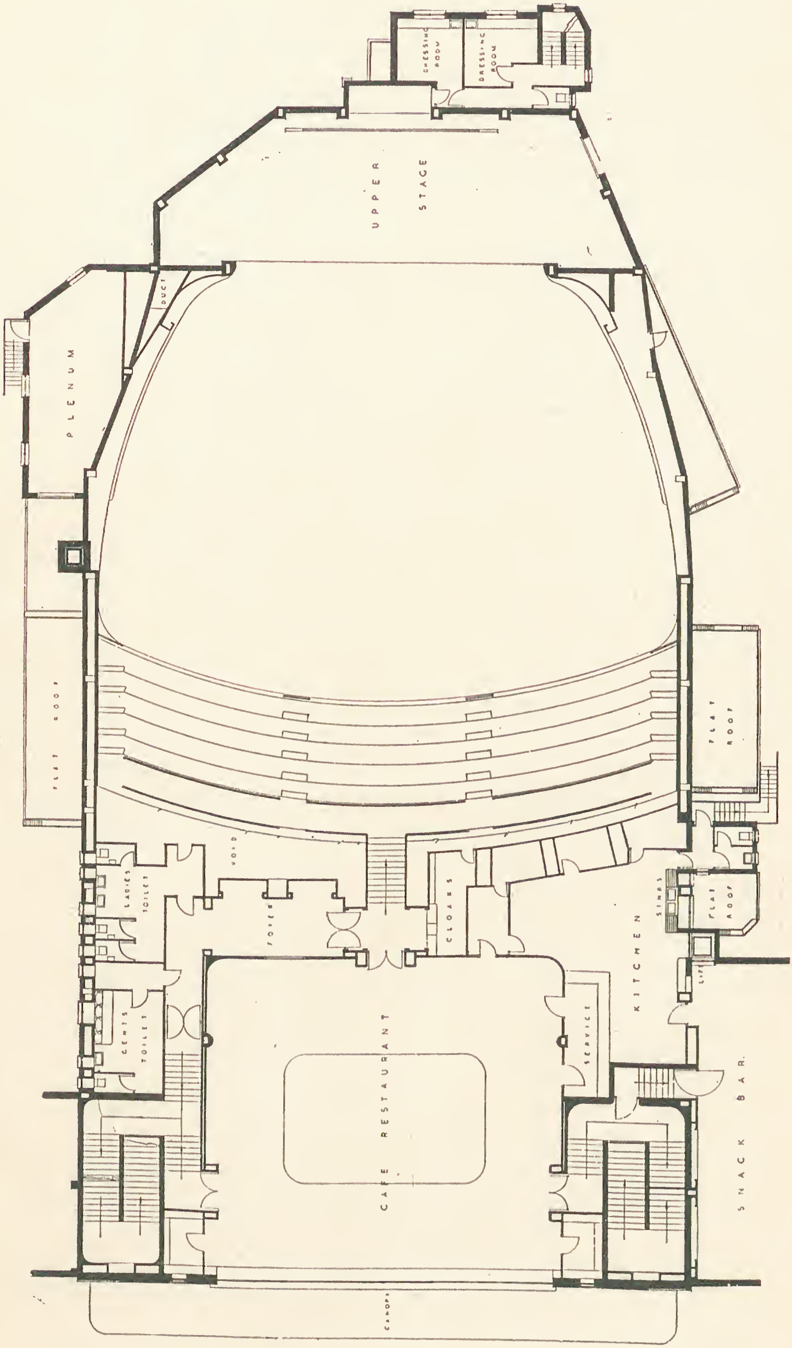


Fig. 9.—LOWER BALCONY PLAN

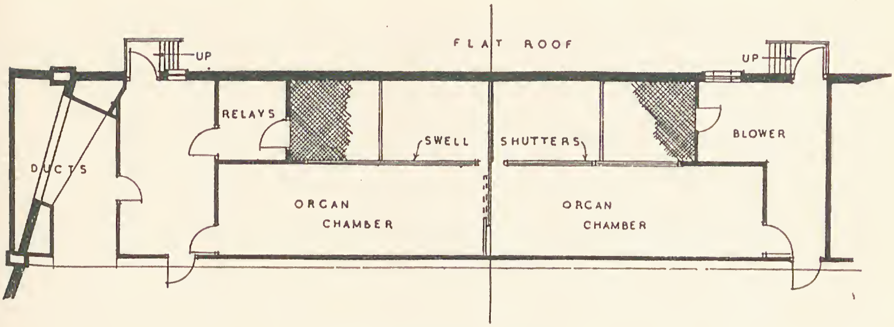


Fig. 10.—ORGAN PLAN

be avoided. Cinema owners are prone to neglect their canopies, and indeed the whole of their cinema façades.

Exterior Illumination

Flood-lighting is desirable, and neon inevitable. The floods should be sunk invisibly into the forefront of the canopy, the roof of which slopes away from the wall towards the fascia.

Neon outlining, now an established addition to night-life, and a disfiguring excrescence by day, should be dealt with as cannily as possible, so as to avoid the appearance of transformers and connecting wiring on the wall surface. Each letter in a sign should be fixed separately—projecting slightly clear of the wall—the extra cost of a few holes punched through the brickwork and the careful hiding of the transformers is well expended—but electrical engineers exhibit a petrifying nonchalance in this part of their work.

Mounting glass towers of Continental type are very effective at night—but are not always attractive in daylight. Beacons of any sort are not regarded favourably by the Air Ministry.

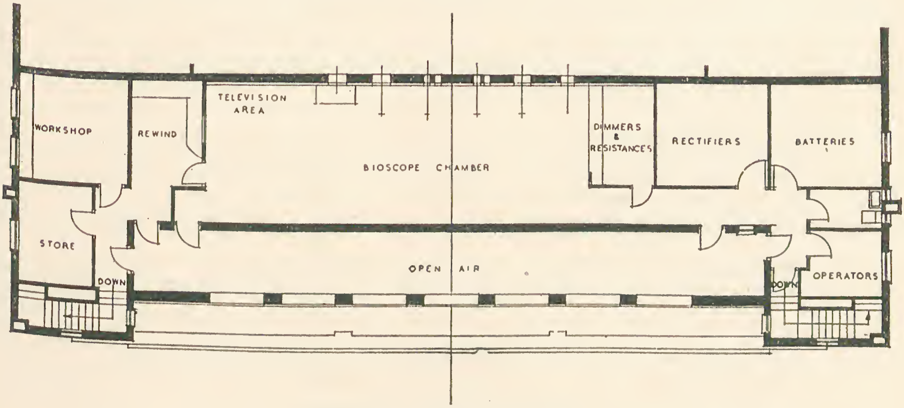


Fig. 11.—BIOSCOPE PLAN

Fig. 12.—ODEON CINEMA, WESTON-SUPER-MARE, WITH SEATING CAPACITY FOR 1,200 PEOPLE
(*Architect: T. Cecil Howitt, F.R.I.B.A.*)

Note the great foyer window, which relieves and counterbalances the large areas of walling above the main entrance. Broad parapets terminate the extremities of walls against the skyline. Over the pavements, a projecting marquise and canopies extend the whole length of entrances and shopping façades. The ground-floor plan is shown on the facing page.

Acoustics

Acoustic correction is usually only needed when there is definite fault. A correctly designed auditorium of usual size does not necessarily require any treatment, but reconstructed theatres, possessing the characteristic horse-shoe shape of Victorian music-halls, require sound absorbents as an antidote to high or curved ceilings, domes, etc. Absorbent material or fluting may effectively be used at the rear of stalls and balcony in most cinemas—but the ever-varying conditions affecting sound reproduction make perfect audition an ideal which cannot always be achieved, but the basic principles affecting designing for good acoustics should be assimilated from Professor Sabine's experiments.

Projection Department

Although the Home Office manual on safety requirements in theatres, etc., entirely ignores the existence of film projection, most local authorities have definite and often contradictory views on the layout of the projection department. In actual fact, provided the plan is based upon common sense, the safety of the public depends much upon the reliability of the operator and his cool-headed behaviour during a film flare. The absence of readily inflammable material, the installation of correct and properly made electrical equipment, *the maintenance of the machines and plant in decent working condition*, are the essentials to

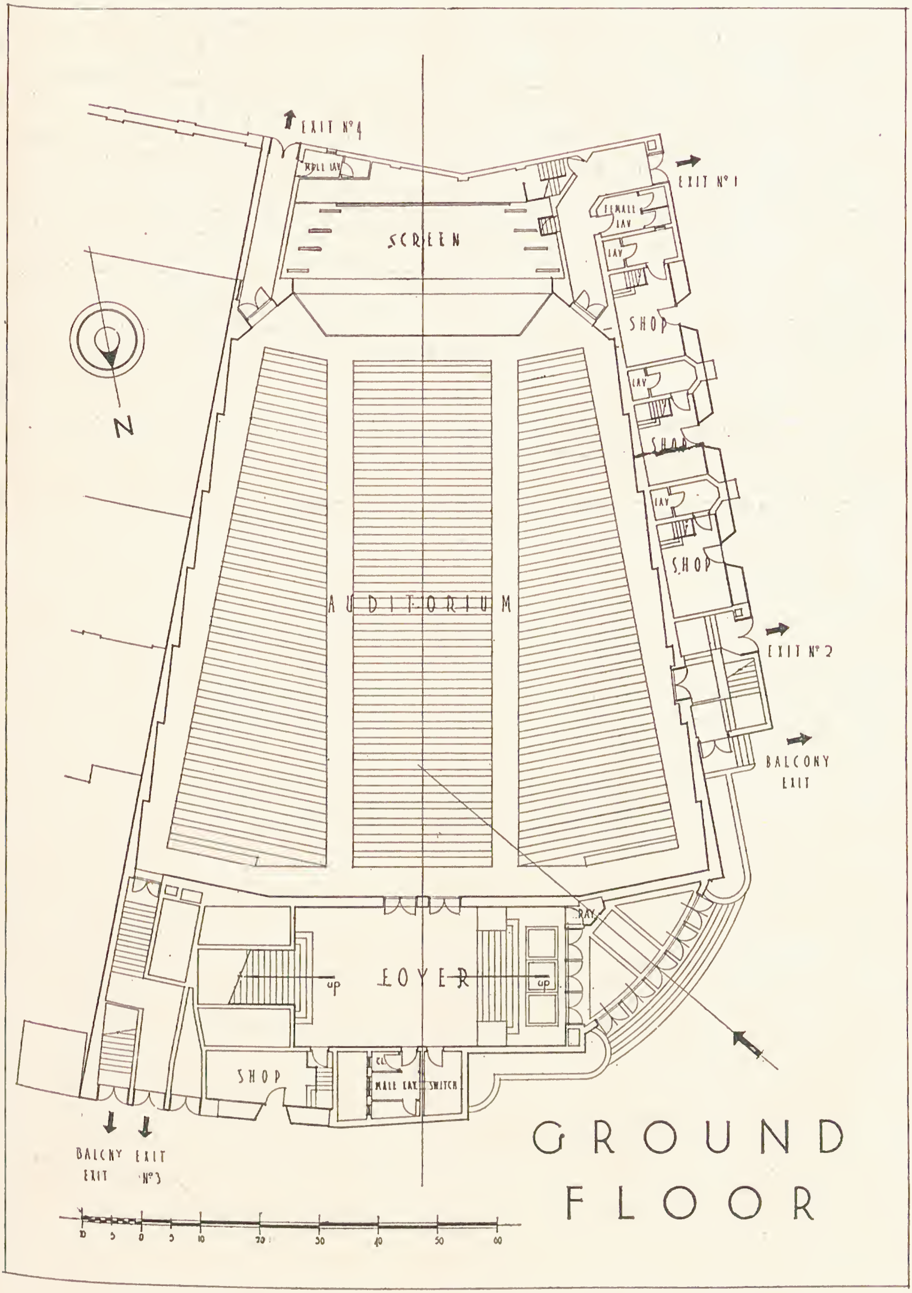


Fig. 13.—PLAN OF THE ODEON CINEMA, WESTON-SUPER-MARE (*Architect : T. Cecil Howitt, F.R.I.B.A.*)

Note the ample provision of exits.

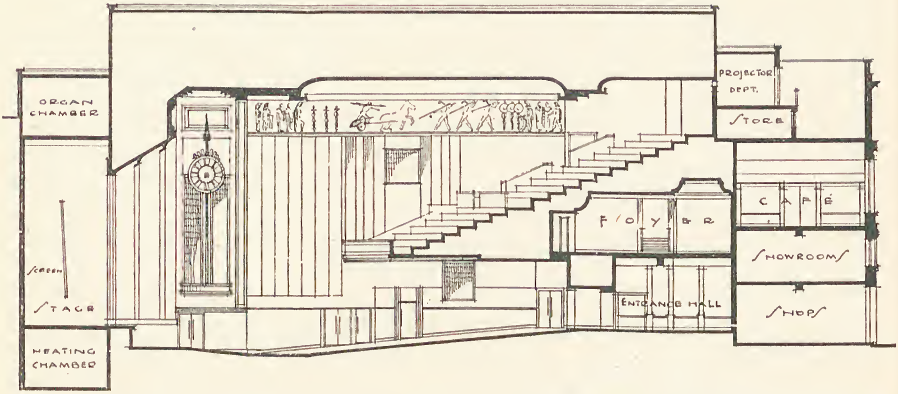


Fig. 14.—SECTION OF FORUM CINEMA, BATH. (*Architect: W. H. Watkins and E. C. Morgan Millmott, FF.R.I.B.A.*)

safety. The minimum requirements are two projectors, two spot-lights, dimmer controls and resistances, sound equipment, lighting and curtain controls, re-wind room, rectifier and battery rooms, electrician's store and repair shop, operator's room and lavatory.

Access to the projection department should be possible from one of the two staircases—entrance to and exit from the projection chamber and re-wind through open-air lobbies—and generally two separate exits from each part containing electrical plant, so as to avoid any possibility of a man becoming trapped.

Batteries used for secondary lighting should be well ventilated, but screened from direct rays of the sun. All rooms containing fire-risks require automatic roof lanterns.

Television

With the prospects of television becoming a vital consideration in present-day entertainment, the cinematograph theatre is befitting as its natural home. That pictures (of small scale) have already been screened augurs a not very distant commercial possibility, and in designing a modern cinema some thought should be given to the probability of television apparatus having to be installed. At the moment little information is available, but it would appear to be only a wise precaution to extend the working space in projection chambers about 10 ft., so as to be in a position, as far as possible, to meet the inevitable.

BUILDERS' ESTIMATING

PART II.—STONEWARE DRAINS AND BRICKLAYER

THE following labour values are for laying and jointing stoneware pipes to a depth not exceeding 15 ft. For drains laid at a depth exceeding 15 ft., a slightly increased value should be used, to provide for the extra labour in handling the pipes.

When the total quantity of drainage work is of small extent the labour values should be increased by about 33 per cent.

The values given are equal times of bricklayer and labourer.

4-in. diameter pipe	$\frac{1}{10}$ hour per foot run.
6-in. " "	$\frac{1}{7}$ " " " "
9-in. " "	$\frac{1}{5}$ " " " "
12-in. " "	$\frac{1}{4}$ " " " "

Jointing and Waste Values

Cost of cement and gasket for joints, based upon 2-ft. lengths of pipe.

4-in. diameter pipe	$\frac{1}{2}d.$ per foot run.
6-in. " "	$\frac{1}{2}d.$ " " "
9-in. " "	$\frac{3}{4}d.$ " " "
12-in. " "	$1\frac{1}{4}d.$ " " "

A drain pipe measures its full length when laid, i.e. the length is measured exclusive of the socket, and runs of pipe are normally measured in multiples of 2 ft. A waste allowance of $2\frac{1}{2}$ per cent. will cover breakage waste.

Price of Stoneware Drain Pipes

The price of stoneware drain pipes is governed by a standard list. The list prices are subject to a buying discount which varies with the quantity purchased. Discounts are also varied to suit market fluctuations.

Pipes of special type are also based upon the standard list prices, the normal buying discounts being reduced by percentage amounts varying with the type of pipe.

Second-quality pipes, often used for rain-water drains, are subject to a discount of 15 per cent. off the net price of best-quality pipes.

Current buying prices :—

Small quantities	plus $2\frac{1}{2}$ per cent. on standard list price.
Two-ton lots	less $27\frac{1}{2}$ per cent. off " " "

EXTRACT FROM STANDARD LIST OF STONEWARE PIPES

Price per foot run	*Diameter of Pipe* 4 *in.*	6 *in.*	9 *in.*	12 *in.*
Ordinary best-quality pipes	10*d.*	1*s.* 3*d.*	2*s.* 3*d.*	3*s.* 9*d.*
Salt-glazed channel pipes	7½*d.*	11¼*d.*	1*s.* 8¼*d.*	2*s.* 9¾*d.*

Pipes of Special Quality

The current discounts for ordinary best-quality pipes are reduced by the following amounts :—

British standard pipes	7½ per cent.
Tested pipes	25 ,, ,,
British standard tested pipes	32½ ,, ,,
Pipes with canvas bags for jointing	5 ,, ,,
Hassall's single-lined joint, or any joint with two rings of composition ..	20 ,, ,,
Hassall's double-lined joint, or any joint with four rings of composition ..	42½ ,, ,,

The standard list should be consulted for pipes of other diameters, for special pipes not described above, and for fittings.

Bends, Junctions, and Other Fittings

All fittings are subject to the same discounts as pipes. The prices and descriptions of various makes of gullies, interceptors, and similar fittings are given in the standard list.

Bends, junctions, tapers, etc., are priced as being of equal value to a given length of drain pipe, and the following are typical examples :—

Bends 2-in. to 12-in. diameter	Charged as 3-ft. run of pipe.
Bends over 12-in. diameter	,, ,, 6-ft. ,, ,, ,,
Single junctions	,, ,, 4-ft. ,, ,, ,,
Taper pipes not exceeding 2 ft. long, ordinary pattern ..	,, ,, 4-ft. ,, ,, ,,

EXTRA LABOUR VALUES LAYING AND JOINTING

		Diameter of Pipe			
		4 *in.*	6 *in.*	9 *in.*	12 *in.*
EXTRA VALUE OVER STRAIGHT PIPES		*s. d.*	*s. d.*	*s. d.*	*s. d.*
Bends	Each	4	6	9	1 0
Taper pipes	,,	4	6	9	1 0
Single junctions	,,	6	9	1 0	1 4
BEDDING AND JOINTING					
Gullies	Each	1 3	2 0	—	—
Interceptors	,,	1 9	2 6	3 6	4 9

Examples of Detailed Price Analysis

(Based on two-ton quantities.)

(17) *4-in. diameter stoneware pipe, laid and jointed.*

		£	s.	d.
1-ft. run 4-in. diameter pipe at standard list price	10*d.*			
Less buying discount for two-ton lots, 27½ per cent. ..	2¾*d.*			
				7¼
Jointing material				½
Bricklayer and labourer, $\frac{1}{10}$ hour	@ 2*s.* 11*d.*			3½
Per foot run, net				11¼

(18) *4-in. diameter second-quality stoneware pipe.*

		£	s.	d.
1-ft. run 4-in. diameter pipe, net	7¼*d.*			
Less 15 per cent. from net price for second-quality pipes, say	1*d.*			
				6¼
Laying and jointing, as example No. 17				4
Per foot run, net				10¼

(19) *4-in. diameter tested stoneware pipe.*

			£	s.	d.
1-ft. run 4-in. diameter pipe at standard list price		10*d.*			
Less buying discount	27½ per cent.				
Reduction on buying discount for tested pipes	25 per cent.				
Net discount	2½ per cent.	¼			9¾
Laying and jointing as before					4
Per foot run, net				1	1¾

(20) *4-in. diameter stoneware bend.*

		£	s.	d.
One 4-in. diameter stoneware bend (as 3-ft. run of 4-in. pipe)	@ 7¼*d.* net		1	9¾
Material for one joint				1
Extra labour, laying and jointing				4
			2	2¾
Less length of drain pipe displaced by bend, say, average 1-ft. run				7¼
Extra value, each, net			1	7½

(21) *4-in. diameter stoneware junction.*

		£	s.	d.
One 4-in. diameter stoneware junction (as 4-ft. run of 4-in. pipe)	@ 7¼*d.* net		2	5
Materials for one joint				1
Extra labour, laying and jointing				6
			3	0
Less length of drain pipe displaced by junction, 2-ft. run			1	2½
Extra value, each, net			1	9½

(22) *6-in. diameter stoneware interceptor.*

		£	s.	d.
One 6-in. diameter stoneware interceptor at standard list price	£1 2 6			
Less buying discount 27½ per cent.	6 2¼			
			16	3¾
Materials for joint				1
Fine concrete for setting, say, 2-ft. cube	@ 9*d.*		1	6
Labour, bedding and jointing			2	6
Each, net		£1	0	5

STONEWARE DRAIN PIPES AND FITTINGS, LAID AND JOINTED

Net Cost Prices

Buying Price of Pipes	Pipes, per foot run				Bends each (extra value)				Junctions each (extra value)			
	4 in.	6 in.	9 in.	12 in.	4 in.	6 in.	9 in.	12 in.	4 in.	6 in.	9 in.	12 in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Plus 20 per cent.	1 4½	2 1⅛	3 6	5 5¼	2 5	3 7	6 3⅜	10 1¼	2 7	3 10	6 6⅜	10 5¼
,, 17½ ,, ,, ...	1 4¼	1 11¾	3 5¼	5 4⅛	2 4½	3 6¼	6 2	9 11	2 6½	3 9¼	6 5	10 3
,, 15 ,, ,, ...	1 4	1 11⅜	3 4½	5 3	2 4	3 5½	6 0⅝	9 8¾	2 6	3 8½	6 3⅝	10 0¾
,, 12½ ,, ,, ...	1 3¾	1 11	3 3¾	5 1⅞	2 3½	3 4¾	5 11¼	9 6½	2 5½	3 7¾	6 2¼	9 10½
,, 10 ,, ,, ...	1 3½	1 10⅝	3 3	5 0¾	2 3	3 4	5 10	9 4¼	2 5	3 7	6 1	9 8¼
,, 7½ ,, ,, ...	1 3¼	1 10¼	3 2¼	4 11½	2 2½	3 3¼	5 8⅝	9 2	2 4½	3 6¼	5 11⅝	9 6
,, 5 ,, ,, ...	1 3	1 9⅞	3 1½	4 10¼	2 2	3 2½	5 7¼	8 11¾	2 4	3 5½	5 10¼	9 3¾
,, 2½ ,, ,, ...	1 2¾	1 9½	3 0¾	4 9⅛	2 1½	3 1¾	5 5⅞	8 9½	2 3½	3 4¾	5 8⅞	9 1½
Standard list price	1 2½	1 9⅛	3 0	4 8	2 1	3 1	5 4½	8 7¼	2 3	3 4	5 7½	8 11¼
Less 2½ per cent.	1 2¼	1 8¾	2 11¼	4 6⅞	2 0½	3 0¼	5 3¼	8 5	2 2½	3 3¼	5 6¼	8 9
,, 5 ,, ,, ...	1 2	1 8⅝	2 10½	4 5¾	2 0	2 11½	5 1⅞	8 2¾	2 2	3 2½	5 4⅞	8 6¾
,, 7½ ,, ,, ...	1 1¾	1 8	2 9¾	4 4⅝	1 11½	2 10¾	5 0½	8 0½	2 1½	3 1¾	5 3½	8 4½
,, 10 ,, ,, ...	1 1½	1 7⅝	2 9	4 3½	1 11	2 10	4 11⅛	7 10¼	2 1	3 1	5 2⅛	8 2¼
,, 12½ ,, ,, ...	1 1¼	1 7¼	2 8¼	4 2⅜	1 10½	2 9¼	4 9¾	7 8	2 0½	3 0¼	5 0¾	8 0
,, 15 ,, ,, ...	1 1	1 6⅞	2 7½	4 1¼	1 10	2 8½	4 8½	7 5¾	2 0	2 11½	4 11½	7 9¾
,, 17½ ,, ,, ...	1 0¾	1 6½	2 6¾	4 0⅛	1 9½	2 7¾	4 7⅛	7 3½	1 11½	2 10¾	4 10⅛	7 7½
,, 20 ,, ,, ...	1 0½	1 6⅛	2 6	3 11	1 9	2 7	4 5¾	7 1¼	1 11	2 10	4 8¾	7 5¼
,, 22½ ,, ,, ...	1 0¼	1 5¾	2 5¼	3 9⅞	1 8½	2 6¼	4 4⅜	6 11	1 10½	2 9¼	4 7⅜	7 3
,, 25 ,, ,, ...	1 0	1 5⅜	2 4½	3 8¾	1 8	2 5½	4 3	6 8¾	1 10	2 8½	4 6	7 0¾
,, 27½ ,, ,, ...	11¾	1 5	2 3¾	3 7⅝	1 7½	2 4¾	4 1¾	6 6½	1 9½	2 7¾	4 4¾	6 10½
,, 30 ,, ,, ...	11½	1 4⅝	2 3	3 6½	1 7	2 4	4 0⅜	6 4¼	1 9	2 7	4 3⅜	6 8¼
,, 32½ ,, ,, ...	11¼	1 4¼	2 2¼	3 5⅜	1 6½	2 3¼	3 11	6 2	1 8½	2 6¼	4 2	6 6
,, 35 ,, ,, ...	11	1 3⅞	2 1½	3 4¼	1 6	2 2½	3 9⅝	5 11¾	1 8	2 5½	4 0⅝	6 3¾
,, 37½ ,, ,, ...	10¾	1 3½	2 0⅞	3 3⅛	1 5½	2 1¾	3 8¼	5 9½	1 7½	2 4¾	3 11¼	6 1½
,, 40 ,, ,, ...	10½	1 3⅛	2 0¼	3 2	1 5	2 1	3 7	5 7¼	1 7	2 4	3 10	5 11¼
,, 42½ ,, ,, ...	10¼	1 2¾	1 11⅝	3 0⅞	1 4½	2 0¼	3 5⅝	5 5	1 6½	2 3¼	3 8⅝	5 9
,, 45 ,, ,, ...	10	1 2⅜	1 11	2 11¾	1 4	1 11½	3 4¼	5 2¾	1 6	2 2½	3 7¼	5 6¾
,, 47½ ,, ,, ...	9¾	1 2	1 10⅜	2 10⅝	1 3½	1 10¾	3 2⅞	5 0½	1 5½	2 1¾	3 5⅞	5 4½
,, 50 ,, ,, ...	9½	1 1⅝	1 9¾	2 9½	1 3	1 10	3 1½	4 10¼	1 5	2 1	3 4½	5 2¼

Tabulated Values for Stoneware Drains

The values given are for best-quality pipes, and are based upon a combined rate for bricklayer and labourer at 2*s.* 11*d.* per hour.

For each 1*d.* per hour variation on the combined rates of bricklayer and labourer, the following adjustments are necessary :—

4-in. diameter pipe	.. ..	$\frac{1}{10}$*d.* per foot run.
6-in. ,, ,,	.. ..	$\frac{1}{7}$*d.* ,, ,, ,,
9-in. ,, ,,	.. ..	$\frac{1}{5}$*d.* ,, ,, ,,
12-in. ,, ,,	.. ..	$\frac{1}{4}$*d.* ,, ,, ,,

For second-quality pipes, deduct the difference between the net price of ordinary best-quality and second-quality pipes, from the tabulated figures.

MANHOLES

Excavation, Concrete, and Brickwork

Work in manholes is billed in full detail, and the unit cost values given under the trade headings will apply.

The following additional sundry labours are net cost values :—

LAYING CHANNEL PIPES AND CHANNEL BENDS IN FLOORS OF MANHOLES

INCLUDING BEDDING IN FINE CONCRETE AND FLAUNCHING

		Diameter of Channel			
		4 *in.*	6 *in.*	9 *in.*	12 *in.*
		s. d.	*s. d.*	*s. d.*	*s. d.*
Channels and half-section bends ..	Each	1 0	1 3	1 9	2 3
Three-quarter-section bends	,,	1 6	1 9	2 3	3 0

Building in manhole steps	6*d.* each
Bedding and sealing manhole covers weighing up to 1 cwt. each	1*s.* 6*d.* ,,
,, ,, ,, ,, ,, ,, above 1 cwt. and not exceeding 2 cwt.	2*s.* 3*d.* ,,
Building in pipes to sides of manhole, up to 6-in. diameter	9*d.* ,,
,, ,, ,, ,, over 6-in. diameter to 12-in. diameter	1*s.* 0*d.* ,,

(23) 6-*in. white-glazed channel pipe,* 2 *ft. long, bedding in fine concrete and flaunching in cement and sand.*

	s. d.	*s. d.*
One 6-in. white-glazed channel 2 ft. long (white-glazed ware list price)	5 4	
Plus 5 per cent. (present buying plusage)	3¼	
		5 7¼
Fine concrete and cement and sand		9
Labour, bedding and flaunching		1 3
Net cost, each		7 7¼

(24) *Three-quarter-section white-glazed Barron bend, 6-in. diameter, including bedding and flaunching.*

	s.	d.	£	s.	d.
One ¾-section 6-in. diameter white-glazed Barron bend—list price	9	7			
Plus 5 per cent.		6			
				10	1
Fine concrete and cement and sand				1	3
Labour, bedding and flaunching				1	9
Net cost, each				13	1

(NOTE.—The price of white-glazed channels, etc., is given in a special standard list, and is not subject to the same buying discount as salt-glazed goods.)

(25) *24-in. by 24-in. cast-iron manhole cover, weighing 2 cwt., bedding in cement and sand and sealing with grease.*

		£	s.	d.
One 24-in. by 24-in. by 2-cwt. cast-iron manhole cover (not galvanised)	@ 12*s.* cwt.	1	4	0
¼ bush. cement and sand	@ 1*s.* ..			3
1 lb. manhole grease				6
Labour, bedding and sealing			2	3
Net cost, each		£1	7	0

BRICKLAYER

Materials

Bricks

The net quantity of bricks required per rod of reduced brickwork, with bricks size 8¾ in. by 4¼ in. by 2⅝ in. thick, rising four courses to one foot in height, is 4,352. A small allowance for breakage waste in transit, say 2 per cent., should be added to this quantity.

In the standard method of measurement, no deductions are made from the brickwork for flues under 18 in. by 18 in., or for strings, cills, and lintels not exceeding 3 in. in height. Some allowance should be made from the net quantity of bricks required, to compensate for these omissions.

The following quantities of bricks per rod are suggested for practical purposes :—

(*a*)	Solid walls, such as boundary walls, half-brick walls, and brickwork in underpinning	4,400
(*b*)	Brickwork where some saving may be expected from the omission of 3-in. courses, but containing no flues under 18 in. by 18 in.	4,330
(*c*)	Brickwork of a domestic character, with brick flues under 18 in. by 18 in. ..	4,200

Mortar

The quantity of mortar required per rod of brickwork varies chiefly with the thickness of bed and the thickness of wall. Side joints are normally ¼ in. thick, and a small difference in the length of the building brick makes no appreciable difference to the total quantity of mortar required. Variation in bond may make some small difference to the quantity of mortar per rod.

Single-frogged bricks require about $\frac{1}{2}$ yd. cube of mortar per rod more than wire-cuts, assuming the frog is fully filled with mortar.

The quantity of mortar varies $\frac{1}{4}$ yd. cube per rod of brickwork for each half-brick in thickness of wall up to $1\frac{1}{2}$ brick in thickness. For walls above $1\frac{1}{2}$ brick thick, the variation in the amount of mortar required per rod, due to the thickness of wall, is very small.

The following quantities of mortar per rod of reduced brickwork are based upon bricks measuring $8\frac{3}{4}$ in. by $4\frac{1}{4}$ in. by $2\frac{5}{8}$ in., with $\frac{3}{8}$-in. beds and $\frac{1}{4}$-in. side joints.

	Wire-cuts	*Bricks with Single Frog*	*Bricks with Double Frog*
Half-brick walls	2 yd. cube	$2\frac{1}{2}$ yd. cube	3 yd. cube
One-brick walls	$2\frac{1}{4}$,, ,,	$2\frac{3}{4}$,, ,,	$3\frac{1}{4}$,, ,,
Walls $1\frac{1}{2}$ brick thick and over	$2\frac{1}{2}$,, ,,	3 ,, ,,	$3\frac{1}{2}$,, ,,

The cost of mortar per yard cube can be calculated in a manner similar to that given for concrete with graded aggregates in Example No. 10, allowing 25 per cent. shrinkage from total bulk for lump lime mortar, and 20 per cent. shrinkage for cement mortar. The weight of grey-stone lime in medium-sized lumps is taken at 56 lb. per bushel.

(26) 1 : 2 *Grey-stone lime mortar*

		£	s.	d.
1 yd. cube—$10\frac{1}{2}$ cwt. grey-stone lime ..	@ 42*s.* 0*d.* ton	1	2	1
Hire of, say, 10 sacks	@ 3*d.* ..		2	6
2 yd. sand	@ 7*s* 0*d.* ..		14	0
		1	18	7
Add one-third to provide 25 per cent. shrinkage from bulk	..		12	10
		3)2	11	5
Materials per yard cube	..		17	2
Mixing mortar—Labourer, 4 hours	@ 1*s.* 3*d.* ..		5	0
	Per yard cube, net	£1	2	2

(27) 1 : 3 *Portland cement mortar.*

		£	s.	d.
1 yd. cube—$1\frac{1}{11}$ ton Portland cement ..	@ 39*s.* 0*d.* ton	2	2	6
3 yd. sand	@ 7*s.* 0*d.* ..	1	1	0
		3	3	6
Add $\frac{1}{4}$ to provide 20 per cent. shrinkage from bulk ..	.. ..		15	10
		4)3	19	4
Materials per yard cube	.. .. ..		19	10
Mixing mortar—Labourer, 6 hours	@ 1*s.* 3*d.* ..		7	6
	Per yard cube, net	£1	7	4

Scaffold

(*a*) *Putlog Scaffold*

For brick-faced buildings of simple character, when the proportion of openings to the brickwork area is not large, a pole and putlog scaffold

will be sufficient, and it is often convenient to include the value of a scaffold of this nature with the unit price of the brickwork.

The cost for erection, striking, and cartage of a timber pole and putlog scaffold, assuming that the depreciation is charged as a general overhead expense, is about 4*d*. per yard super of scaffold area, an average value of, say, 15*s*. per rod for walls of reduced thickness with a normal proportion of door and window openings.

Depreciation of timber scaffold, based upon 25 per cent. depreciation for scaffold boards and 16 per cent. for the remainder of scaffolding, amounts to approximately 4*d*. per yard super of scaffold area per annum. The annual depreciation of a steel tube and putlog scaffold may be taken at the same figure.

(*b*) *Independent Scaffold*

In work of larger extent, and in work where the building is faced with material other than brick, or the openings are large in area, an independent scaffold will probably be necessary. In this case the quantity of brickwork may have no relation to the amount of scaffold required, and the scaffolding should be charged as a plant item in the preliminary bill.

The cost of erecting and striking an independent steel scaffold is approximately 10*d*. per yard super. Cartage of scaffolding, about 1*d*. per yard super each way. Depreciation, allowing 6 per cent. depreciation on tubes and fittings and 25 per cent. on scaffold boards, is approximately 7*d*. per yard super per annum.

If depreciation of the scaffold is directly priced in the estimate, the duration of the contract must be considered in relation to the annual depreciation value.

When the scaffold is hired, the cost must be added to the cost of erection, cartage, etc. An independent scaffold, hired for three months (excluding cartage), will cost approximately 9*d*. per yard super of scaffold area.

Labour per Rod of Reduced Brickwork

The labour value per rod of reduced brickwork is based upon building walls one brick or over in thickness, exclusive of all cuttings and faced work. In London practice, the labour also includes all plumbing to angles in common brickwork. The outputs given are based upon London practice.

An output of 600 bricks per day in lime mortar should be regarded as the maximum for a straightforward building, and this output should be adjusted to suit the proportion of openings, piers, etc., in the building. The output will be reduced when cement mortar is used.

For work other than of small dimensions, two labourers should serve three bricklayers in building common brickwork. This proportion will be reduced when the bricklayer is building work of a superior character,

i.e. faced work, etc., provided suitable regulation of labourer's work can be arranged.

The labour values are based upon 4,330 bricks per rod, but for practical purposes may be used for all types of common brickwork.

LABOUR VALUES PER ROD OF REDUCED BRICKWORK

	Bricklayer hours	Labourer hours
Brickwork in lime mortar		
Output 600 bricks per day of 8 hours	58	39
,, 550 ,, ,, ,, ,,	63	42
,, 500 ,, ,, ,, ,,	69	46
Additional labour		
Extra labour in half-brick walls	15	—
,, ,, ,, brickwork in backing to masonry	10	—
,, ,, ,, ,, built circular, flat sweep	10	—
,, ,, ,, ,, ,, ,, quick sweep	24	—
,, ,, ,, ,, in 16-in. cavity walls, $4\frac{1}{2}$-in. exterior and 9-in. interior	20	—
,, ,, ,, ,, in 11-in. cavity walls, two $4\frac{1}{2}$-in. thicknesses	34	—
,, ,, ,, building brickwork in cement mortar	$4\frac{1}{2}$	—

Examples of Detailed Price Analysis

The following examples are based upon an output of 550 bricks per day. They are for work of a non-domestic character, and do not include for scaffold.

(28) *Reduced Fletton brickwork in* 1 : 2 *lime mortar.*

		£	s.	d.
$4\frac{1}{3}$ thousand Fletton bricks d/d London, rate station	@ 46*s.* 3*d.*	10	0	5
Unloading, carting, and stacking	@ 6*s.* 0*d.*	1	6	0
3 yd. cube 1 : 2 lime mortar (Example No. 23)	@ 22*s.* 2*d.*	3	6	6
Bricklayer, 63 hours	@ 1*s.* 8*d.*	5	5	0
Labourer, 42 ,,	@ 1*s.* 3*d.*	2	12	6
	Per rod reduced, net	£22	10	5

(NOTE.—When the brickwork is billed in yards super reduced to one brick in thickness, divide the price per rod by $45\frac{1}{3}$, the number of yards super of one brick wall per rod.)

(29) *Reduced Fletton brickwork in* 1 : 3 *cement mortar.*

			£	s.	d.
$4\frac{1}{3}$ thousand Fletton bricks at station		@ 46*s.* 3*d.*	10	0	5
Unloading, carting, and stacking		@ 6*s.* 0*d.*	1	6	0
3 yd. cube 1 : 3 cement mortar (Example No. 24)		@ 27*s.* 4*d.*	4	2	0
Bricklayer. Basis labour in lime mortar	63 hours				
Extra labour building in cement mortar	$4\frac{1}{2}$,,				
Total	$67\frac{1}{2}$,,	@ 1*s.* 8*d.*	5	12	6
Labourer, 42 hours		@ 1*s.* 3*d.*	2	12	6
		Per rod reduced, net	£23	13	5

(30) *Half-brick wall built of grooved Fletton bricks in* 1 : 3 *cement mortar.*

Basis price per rod			£	s.	d.
$4\frac{2}{5}$ thousand Fletton bricks		@ 46*s.* 3*d.*	10	3	6
Extra for grooved Flettons		@ 2*s.* 0*d.*		8	10
Unloading, carting, and stacking		@ 6*s.* 0*d.*	1	6	5
$2\frac{1}{2}$ yd. cube 1 : 3 cement mortar		@ 27*s.* 4*d.*	3	8	4
Bricklayer. Basis labour in lime mortar	63 hours				
Extra for building half-brick wall	15 ,,				
Extra for building in cement mortar	$4\frac{1}{2}$,,				
Total	$82\frac{1}{2}$,,	@ 1*s.* 8*d.*	6	17	6
Labourer, 42 hours		@ 1*s.* 3*d.*	2	12	6
Basis price per rod reduced, net			£24	17	1

Price per foot super half-brick thick

$$\frac{£24\ 17s.\ 1d.}{816} = \text{say, } 7\tfrac{1}{4}d. \textit{ per foot super, net.}$$

(31) 11-*in. cavity wall of Fletton brickwork in cement mortar* (1 : 3) *bonded with galvanised wall ties weighing three per pound, spaced four to each yard super. Inside of wall prepared for plastering.*

Basis price per rod			£	s.	d.
$4\frac{2}{5}$ thousand Fletton bricks		@ 46*s.* 3*d.* ..	10	3	6
Unloading, carting, and stacking		@ 6*s.* 0*d.* ..	1	6	5
$2\frac{1}{5}$ thousand, extra for grooved Fletton bricks		@ 2*s.* 0*d.* ..		4	5
$2\frac{1}{2}$ yd. cube 1 : 3 cement mortar		@ 27*s.* 4*d.* ..	3	8	4
181 galvanised iron wall ties, say, 60 lb. ..		@ 14*s.* 0*d.* per cwt.		7	6
Bricklayer. Basis labour in lime mortar	63 hours				
Extra for building 11-in. cavity wall	34 ,,				
Extra for building in cement mortar	$4\frac{1}{2}$,,				
Total	$101\frac{1}{2}$,,	@ 1*s.* 8*d.*	8	9	2
Labourer, 42 hours		@ 1*s.* 3*d.*	2	12	6
Per rod, net			£26	11	10

Per yard super

The net brickwork will be equal to a wall one brick thick, and the area $45\frac{1}{3}$ yd. super per rod.

$$\frac{£26\ 11s.\ 10d.}{45\frac{1}{3}} = 11s.\ 8\tfrac{1}{2}d. \textit{ per yard super, net.}$$

Tabulated Values for Reduced Brickwork

The following Table gives the net cost values per rod of reduced brickwork in lime and cement mortars, at varying prices of bricks per 1,000.

The equivalent number of bricks laid per 8-hour day is given against the total labour cost per rod. These values are based upon brickwork laid in lime mortar, the extra labour and the difference in value between

BRICKWORK—PER ROD REDUCED

Net Cost Values—Exclusive of Scaffold

Price of Bricks Delivered and Stacked on Site	Basic Labour £10 5 0—450 Bricks per Day		Basic Labour £9 7 6—500 Bricks per Day		Basic Labour £8 12 6—550 Bricks per Day		Basic Labour £8 0 0—600 Bricks per Day	
	1 : 2 *L./M.*	1 : 3 *Ct./M.*	1 : 2 *L./M.*	1 : 3 *Ct./M.*	1 : 2 *L./M.*	1 : 3 *Ct./M.*	1 : 2 *L./M.*	1 : 3 *Ct./M.*
s. d.	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*
45 0	22 12 0	23 15 0	21 14 0	22 17 0	20 19 0	22 2 0	20 7 0	21 10 0
47 0	23 0 8	24 3 8	22 2 8	23 5 8	21 7 8	22 10 8	20 15 8	21 18 8
49 0	23 9 4	24 12 4	22 11 4	23 14 4	21 16 4	22 19 4	21 4 4	22 7 4
51 0	23 18 0	25 1 0	23 0 0	24 3 0	22 5 0	23 8 0	21 13 0	22 16 0
53 0	24 6 8	25 9 8	23 8 8	24 11 8	22 13 8	23 16 8	22 1 8	23 4 8
55 0	24 15 4	25 18 4	23 17 4	25 0 4	23 2 4	24 5 4	22 10 4	23 13 4
57 0	25 4 0	26 7 0	24 6 0	25 9 0	23 11 0	24 14 0	22 19 0	24 2 0
59 0	25 12 8	26 15 8	24 14 8	25 17 8	23 19 8	25 2 8	23 7 8	24 10 8
61 0	26 1 4	27 4 4	25 3 4	26 6 4	24 8 4	25 11 4	23 16 4	24 19 4
63 0	26 10 0	27 13 0	25 12 0	26 15 0	24 17 0	26 0 0	24 5 0	25 8 0
65 0	26 18 8	28 1 8	26 0 8	27 3 8	25 5 8	26 8 8	24 13 8	25 16 8
67 0	27 7 4	28 10 4	26 9 4	27 12 4	25 14 4	26 17 4	25 2 4	26 5 4
69 0	27 16 0	28 19 0	26 18 0	28 1 0	26 3 0	27 6 0	25 11 0	26 14 0
71 0	28 4 8	29 7 8	27 6 8	28 9 8	26 11 8	27 14 8	25 19 8	27 2 8
73 0	28 13 4	29 16 4	27 15 4	28 18 4	27 0 4	28 13 4	26 8 4	27 11 4
75 0	29 2 0	30 5 0	28 4 0	29 7 0	27 9 0	28 12 0	26 17 0	28 0 0
77 0	29 10 8	30 13 8	28 12 8	29 15 8	27 17 8	29 0 8	27 5 8	28 8 8
79 0	29 19 4	31 2 4	29 1 4	30 4 4	28 6 4	29 9 4	27 14 4	28 17 4
81 0	30 8 0	31 11 0	29 10 0	30 13 0	28 15 0	29 18 0	28 3 0	29 6 0
83 0	30 16 8	31 19 8	29 18 8	31 1 8	29 3 8	30 6 8	28 11 8	29 14 8
85 0	31 5 4	32 8 4	30 7 4	31 10 4	29 12 4	30 15 4	29 0 4	30 3 4

lime and cement mortar being added in the adjoining column for each basic output.

The prices upon which the Table is based are as follows :—

Bricklayer	1*s.* 8*d.* per hour.
Labourer	1*s.* 3*d.* ,, ,,
Lime	42*s.* 0*d.* ,, ton.
Cement	39*s.* 0*d.* ,, ,,
Sand	7*s.* 0*d.* ,, yard cube.

Adjustments for variations in the wages rates, per rod of reduced brickwork :—

	Basic Output per 8 hours			
	450 *bricks*	500 *bricks*	550 *bricks*	600 *bricks*
	s. d.	*s. d.*	*s. d.*	*s. d.*
For each 1*d.* per hour on bricklayer's rate, brickwork in lime mortar	6 4	5 9	5 3	4 10
For each 1*d.* per hour on bricklayer's rate, brickwork in cement mortar	6 8½	6 1½	5 7½	5 2½
For each 1*d.* per hour on labourer's rate	5 3	4 10	4 6	4 3

Adjustments per rod of reduced brickwork for prices of materials :—

		s. d.
For each 1*s.* per ton in price of lime		1 7
,, ,, 1*s.* ,, ,, ,, ,, cement		1 0
,, ,, 1*s.* per yard cube in price of sand.	Brickwork in lime mortar	2 8
,, ,, 1*s.* ,, ,, ,, ,, ,,	,, ,, cement mortar	2 9¾

Pointing and Facings

Facings are measured extra over the common brickwork, the value of the brick facing being represented by the difference in value of the facing bricks and the building bricks displaced.

Number of bricks required for facings, laid four courses to one foot in height :—

Stretcher bond	50 bricks per yard super.
Flemish bond	63 ,, ,, ,, ,,
English bond	72 ,, ,, ,, ,,

Labour

The output of the bricklayer will be reduced when a wall is faced with superior bricks, and an extra labourer must be provided in addition to the time occupied in raking out the joints of brickwork and pointing.

LABOUR VALUES, PER YARD SUPER

	Hours	
	Bricklayer	*Labourer*
Struck joint as the work proceeds	½	—
Raking out joints and pointing with flush or weather joint in lime mortar	½	¼
Raking out joints and pointing with flush or weather joint in cement mortar	⅔	⅓
Raking out joints and pointing with flush or weather joint to glazed brickwork	1	½
Extra labour laying sand-faced or similar types of facing bricks	⅓	—
Extra labour laying blue Staffordshire or similar types of non-absorbent bricks	¾	—
Extra labour laying glazed facing bricks	1½	—

Examples of Detailed Price Analysis

(32) *Struck joint as the work proceeds.*

		£	s.	d.
Bricklayer, ½ hour	@ 1*s*. 8*d*.			10
No extra materials				—
Per yard super, net				10

(33) *Rake out joints and point with weather joint in cement mortar.*

Bricklayer, ⅔ hour	@ 1*s*. 8*d*.		1	1½
Labourer, ⅓ ,,	@ 1*s*. 3*d*.			5
Materials only for ¼ bush. of 1 : 3 cement mortar (Example No. 27)	@ 1*s*. 0*d*.			3
Per yard super, net			1	9½

(34) *Rake out joints and point with flush joint in white cement mortar.*
Basis price of 1 : 3 *white cement mortar.*

1 yd. ($1\frac{1}{11}$ ton) white Portland cement	@ £8 15 0	9	10	11
3 yd. white silica sand	@ 18*s*. 0*d*.	2	14	0
		12	4	11
Add allowance for shrinkage, 25 per cent.		3	1	3
		4)15	6	2
Materials per yard cube, net		£3	16	6½

Per yard super

Bricklayer, ¾ hour	@ 1*s*. 8*d*.		1	3
Labourer, ⅜ ,,	@ 1*s*. 3*d*.			5½
Materials for ¼ bush. white cement mortar	@ 3*s*. 8*d*. bush.			11
Per yard super, net			2	7½

(NOTE.—The labour in this example has been increased slightly above normal, owing to this type of mortar working very "short.")

(35) *Extra over Fletton brickwork for facing with approved facings, P.C.* 120*s. per* 1,000 *at station, and pointing with flush joint in white cement mortar (English bond).*

	£	s.	d.
1,000 facing bricks at station	6	0	0
Unloading, carting, and stacking		7	0
	6	7	0
Less 1,000 Fletton bricks on site	2	12	3
Extra cost of facing bricks	3	14	9

Extra value of 72 facing bricks	@ £3 14 9	5	5
Extra labour laying facing bricks :—			
Bricklayer, ⅓ hour	@ 1s 8*d*.		6¾
Pointing in white cement mortar (Example No. 34)		2	7½
Per yard super, net		8	7¼

Per foot super

$$\frac{8s.\ 7\frac{1}{4}d.}{9} = 11\frac{1}{2}d.\ net.$$

(36) *Extra over Fletton brickwork for facing with white-glazed bricks, pointed with cement weather joint* (*English bond.*)

			£	s.	d.
24 white-glazed stretchers		@ £23 0 0		11	0½
48 white-glazed headers		@ £22 10 0	1	1	7
Unloading, carting, and stacking 72 glazed bricks		@ 9s. per 1,000			7½
			1	13	3
Deduct 72 Fletton bricks		@ 52s. 3d. on site		3	8½
		Extra cost of bricks	1	9	6½
Extra cost of laying white-glazed facings:—					
Bricklayer, 1½ hours		@ 1s. 8d.		2	6
Pointing:	s. d.				
Bricklayer, 1 hour	1 8	@ 1s. 8d.			
Labourer, ½ ,,	7½	@ 1s. 3d.			
Materials	3			2	6½
		Per yard super, net	£1	14	7

Per foot super

$$\frac{£1\ 14\ 7}{9} = 3s.\ 10d.\ net.$$

Arches

Arches are measured extra over the common brickwork as described for facings, but both the face and soffit are measured.

Bricks required per foot super

Segmental and semicircular arches	10 bricks.
Elliptical arches	12 ,,

Extra labour, including pointing

Fair-axed segmental arches	½ hr. bricklayer.
Rubbed arches, pointed to match facings	¾ hr. ,,
,, and gauged segmental arches	1¼ hr. ,,
,, ,, ,, elliptical arches	1¾ hr. ,,

Rough relieving arches in half-brick rings, including all cutting around the arch, are worth approximately 3*d.* per foot run of span of arch, for each half-brick in depth of soffit.

(37) *Extra over Fletton brickwork for fair-axed segmental arch in bricks P.C.* 120*s. per* 1,000 *at station.*

		s.	d.
10 facing bricks	@ 127s. 0d. d/d	1	3¼
Less 8 Fletton bricks (English bond)	@ 52s. 0d. d/d		5
	Difference in cost of bricks		10¼
Bricklayer, ½ hour	@ 1s. 8d.		10
Pointing material			½
	Per foot super, net	1	8¾

EXTRA FOR BRICK FACINGS INCLUDING POINTING

NET COST VALUES—PER FOOT SUPER

Difference in Cost between Facing Bricks and Common Bricks, per 1,000 delivered	*Flemish Bond*			*English Bond*		
	Pointing in Lime Mortar	*Pointing in Cement Mortar*	*Pointing in White Cement*	*Pointing in Lime Mortar*	*Pointing in Cement Mortar*	*Pointing in White Cement*
s. *d.*	*d.*	*d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*
5 0	$2\frac{15}{16}$	$3\frac{7}{16}$	$4\frac{9}{16}$	$3\frac{3}{16}$	$3\frac{11}{16}$	$4\frac{13}{16}$
10 0	$3\frac{3}{8}$	$3\frac{7}{8}$	5	$3\frac{5}{8}$	$4\frac{1}{8}$	$5\frac{1}{4}$
15 0	$3\frac{13}{16}$	$4\frac{5}{16}$	$5\frac{7}{16}$	$4\frac{1}{8}$	$4\frac{5}{8}$	$5\frac{3}{4}$
20 0	$4\frac{1}{4}$	$4\frac{3}{4}$	$5\frac{7}{8}$	$4\frac{5}{8}$	$5\frac{1}{8}$	$6\frac{1}{4}$
25 0	$4\frac{11}{16}$	$5\frac{3}{16}$	$6\frac{5}{16}$	$5\frac{1}{16}$	$5\frac{9}{16}$	$6\frac{11}{16}$
30 0	$5\frac{1}{8}$	$5\frac{5}{8}$	$6\frac{3}{4}$	$5\frac{1}{2}$	6	$7\frac{1}{8}$
35 0	$5\frac{9}{16}$	$6\frac{1}{16}$	$7\frac{3}{16}$	6	$6\frac{1}{2}$	$7\frac{5}{8}$
40 0	6	$6\frac{1}{2}$	$7\frac{5}{8}$	$6\frac{1}{2}$	7	$8\frac{1}{8}$
45 0	$6\frac{7}{16}$	$6\frac{15}{16}$	$8\frac{1}{16}$	$6\frac{15}{16}$	$7\frac{7}{16}$	$8\frac{9}{16}$
50 0	$6\frac{7}{8}$	$7\frac{3}{8}$	$8\frac{1}{2}$	$7\frac{3}{8}$	$7\frac{7}{8}$	9
55 0	$7\frac{5}{16}$	$7\frac{13}{16}$	$8\frac{15}{16}$	$7\frac{7}{8}$	$8\frac{3}{8}$	$9\frac{1}{2}$
60 0	$7\frac{3}{4}$	$8\frac{1}{4}$	$9\frac{3}{8}$	$8\frac{3}{8}$	$8\frac{7}{8}$	10
65 0	$8\frac{3}{16}$	$8\frac{11}{16}$	$9\frac{13}{16}$	$8\frac{13}{16}$	$9\frac{5}{16}$	$10\frac{7}{16}$
70 0	$8\frac{5}{8}$	$9\frac{1}{8}$	$10\frac{1}{4}$	$9\frac{1}{4}$	$9\frac{3}{4}$	$10\frac{7}{8}$
75 0	$9\frac{1}{16}$	$9\frac{9}{16}$	$10\frac{11}{16}$	$9\frac{3}{4}$	$10\frac{1}{4}$	$11\frac{3}{8}$
80 0	$9\frac{1}{2}$	10	$11\frac{1}{8}$	$10\frac{1}{4}$	$10\frac{3}{4}$	$11\frac{7}{8}$
85 0	$9\frac{15}{16}$	$10\frac{7}{16}$	$11\frac{9}{16}$	$10\frac{11}{16}$	$11\frac{3}{16}$	1 $0\frac{5}{16}$
90 0	$10\frac{3}{8}$	$10\frac{7}{8}$	1 0	$11\frac{1}{8}$	$11\frac{5}{8}$	1 $0\frac{3}{4}$
95 0	$10\frac{13}{16}$	$11\frac{5}{16}$	1 $0\frac{7}{16}$	$11\frac{5}{8}$	1 $0\frac{1}{8}$	1 $1\frac{1}{4}$
100 0	$11\frac{1}{4}$	$11\frac{3}{4}$	1 $0\frac{7}{8}$	1 $0\frac{1}{8}$	1 $0\frac{5}{8}$	1 $1\frac{3}{4}$

Cuttings

Waste

Allow one brick per foot super for average waste on bricks in rough cutting. For fair cutting allow from one-half to one brick per foot run, according to type of cutting.

Labour

	Bricklayer
Rough cutting to common bricks	$\frac{1}{10}$ hr. per foot super
Rough-cut chamfer	$\frac{1}{12}$ hr. ,, ,, run
,, ,, squint	$\frac{1}{6}$ hr. ,, ,, ,,
,, ,, bird's-mouth	$\frac{1}{6}$ hr. ,, ,, ,,
Fair cutting	$\frac{1}{12}$ hr. ,, ,, ,,
,, circular cutting	$\frac{1}{6}$ hr. ,, ,, ,,
,, raking cutting	$\frac{1}{6}$ hr. ,, ,, ,,
Fair-cut squint	$\frac{1}{2}$ hr. ,, ,, ,,
,, ,, bird's-mouth	$\frac{1}{2}$ hr. ,, ,, ,,

For blue Staffords and similar hard bricks, add 50 per cent. to the above values.

Sundry Labour Values

Special horizontal brick courses	½d. per foot run
,, vertical brick courses	1½d. ,, ,, ,,
Wedging and pointing horizontal flashings	2d. ,, ,, ,,
,, ,, ,, stepped flashings	4½d. ,, ,, ,,
Widen joint of brickwork and point asphalte skirting	3½d. ,, ,, ,,
Bedding frames	2½d. ,, ,, ,,
,, ,, and pointing one side	3d. ,, ,, ,,
,, ,, ,, ,, two sides	3½d. ,, ,, ,,
Horizontal slate damp-proof course	3d. ,, ,, super
Vertical slate damp-proof course	7d. ,, ,, ,,
Forming flues and building in air bricks up to 12 in. by 12 in.	9d. each
Extra on last item for rough-rendering openings in 1-brick walls	6d. ,,
,, ,, ,, ,, ,, ,, in walls over 1 brick thick	9d. ,,
Bedding and flaunching chimney pots up to 2 ft. high	1s. 6d. each

Slab Partitions

Labour values	*Bricklayer and Labourer*
Breeze concrete partition, 3 in. thick	½ hr. per yard super
,, ,, ,, 4 in. ,,	⅝ hr. ,, ,, ,,
Hollow-block partitions, 3 in. thick	⅝ hr. ,, ,, ,,
,, ,, ,, 4 in. ,,	¾ hr. ,, ,, ,,

(38) *Breeze-concrete partition, 4 in. thick.*

		s.	*d.*
1 yd. super 4-in. partition slabs	@ 2*s.* 3*d.*	2	3
Waste, 5 per cent.			1½
¼ bush. cement mortar			3
Bricklayer, ⅝ hour	@ 1*s.* 8*d.*	1	0½
Labourer, ⅝ ,,	@ 1*s.* 3*d.*		9½
	Per yard super, net	4	5½

Straight cutting and waste on 4-in. slabs	3½d. per foot run
Raking cutting and waste on 4-in. slabs	6d. ,, ,, ,,
Wedging and pinning to soffit of floor	4d. ,, ,, ,,

PLANNING AND DESIGN OF DETACHED HOUSES

It is three hundred years since Sir Henry Wotton wrote the well-known words: "Well building hath three conditions—firmeness; commoditie and delight," and if we to-day express the thought in more prosaic language, and speak of a work of architecture demanding sound construction, convenient planning, and charm, we shall be summing up the meaning of good design.

Wotton, as a student of the Italian Renaissance who had travelled extensively in Europe, required simple dignity in design and planning, but many of the present-day architect's problems had not occurred to him.

Fig. 1.—THE PASTURE HOUSE, NORTH LUFFENHAM

Built in brick rough-cast, roofed with green slate. All joinery in oak, left clean from the plane. One of the pioneers of modern house design. (*Architect: C. F. Annesley Voysey, F.R.I.B.A.*)

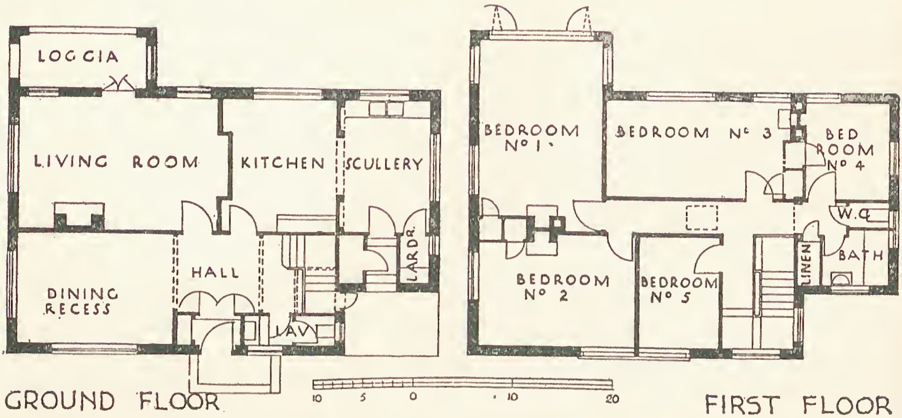


Fig. 2.—EXAMPLE OF MODIFIED "OPEN PLANNING"
Showing plan of house at Jordans, Bucks. (*Architects: Mauger & May, A/F.R.I.B.A.*)

Modern Problems

We may leave "firmeness" or construction mainly for a later consideration of materials, though it must here be said that an important branch of construction is concerned with heat and sound insulation and the avoidance of reverberation inside buildings—questions which did not greatly worry Wotton's contemporaries.

It has been found that good results, consistent with minimum cost, in respect of insulation, depend upon the thickness of surrounding walls and floors and the volume of the roof space. This rough and ready statement will be amplified in later sections dealing with materials, but may suffice for the present purpose. It explains why the use of concrete for external walls is seldom economical. Adequate stability could be achieved for two-storey houses with reinforced-concrete walls 4 in. thick. Without expensive cork or other internal lining, however, such slight walls would make the interior cold in winter and hot in summer, besides being subject to "sweating." The occupants would also suffer from noise penetrating from outside, and reverberation in the rooms themselves.

Cavity brick walls 11 in. thick, properly built, provide good thermal conditions, and if the internal skin were 9 in. thick (giving a 15½-in. wall, which is seldom used), almost perfect conditions as to thermal and sound insulation would be secured. Similar reasons point to houses with pitched roofs being generally more comfortable than those with ordinary flat roofs, though it is possible, if the greater cost may be incurred, to construct the latter so as to give adequate protection from heat and cold, and noise.

PLANNING

The "commoditie" of Wotton's day provided for the north gallery where paintings and tapestries were hung, south kitchens, "stillatories

Fig. 3.—ANOTHER EXAMPLE OF OPEN PLANNING

A house at Wimbledon, from the south. (*Architects: E. C. Kaufmann, Dipl. Ing., and R. E. Benjamin, A.R.I.B.A.*)

and stoves," and east-facing living- and bedrooms. Let us see how we now approach this complicated subject of planning.

Greater equality in living conditions, as between the working and middle classes, has brought the problem of the economical house plan to the fore.

The planning of small houses to-day is influenced primarily by the social changes owing to which the middle classes have come largely to dispense with resident servants, to have smaller families, and to live a less conventional life. An increasing enjoyment of the open air and sunshine is a part of this new outlook, which has largely affected post-war domestic work in England.

Open Planning

These tendencies make for "open planning," which renders housework easier and gives better ventilation and more sunshine. By "open planning," in its ordinary but limited sense, is meant arranging the whole in-

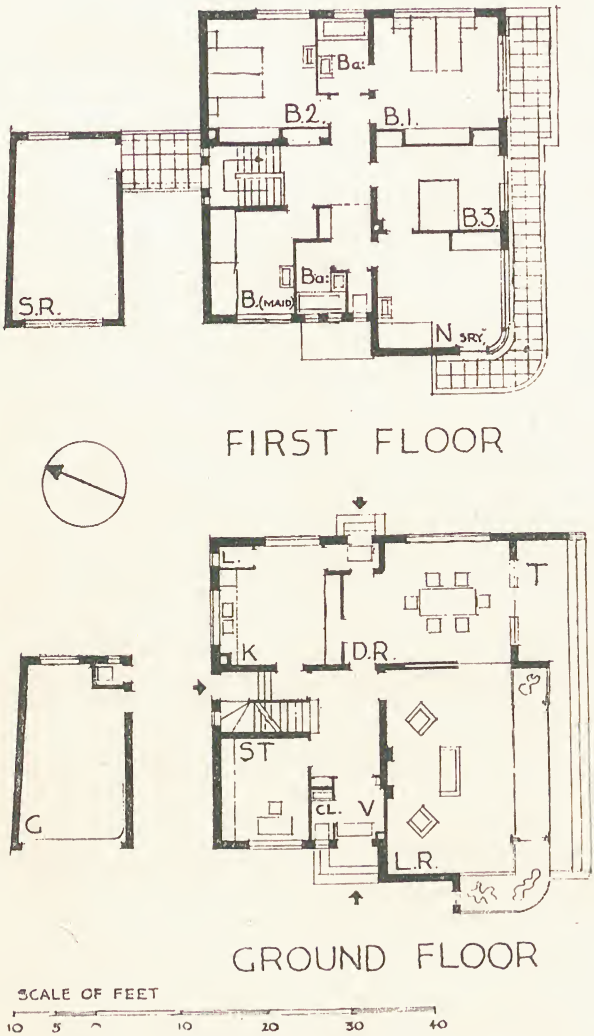


Fig. 4.—PLAN OF HOUSE AT WIMBLEDON

(*Architects: E. C. Kaufmann, Dipl. Ing., and R. E. Benjamin, A.R.I.B.A.*)

terior to give the maximum feeling of space. In its simplest form this may be achieved by uniting rooms by means of openings, with or without folding door or curtains. The plans and photographs of the houses at Jordans and Hampstead Garden Suburb illustrate how this arrangement works out. This method does not, however, carry the idea very far, and hardly embodies the essential nature of open planning, since it still divides the interior into a number of separate rooms within a formal shape. To meet the planning needs referred to above, it is often found that the flat roof presents fewer difficulties than the traditional pitched roof. The completely open plan embraces the whole shell of the house, both horizontally and vertically, and may perhaps be best understood if one thinks of the house not as a series of enclosed rooms, but as a protected part of the garden, where the owner's family may live in such privacy as they may desire. The walls and roof are thus screens, glazed where facing fine views or sunny aspects, and being removable when weather conditions make open-air life enjoyable. The house then becomes part of the garden, and the two merge in loggias, terraces, and sleeping-balconies.

Fig. 5.—THE STAIRS HALL IN A HOUSE AT HAMPSTEAD GARDEN SUBURB
(*Architects: Mauger & May, A/F.R.I.B.A.*)

An Example of Open Planning

The plan and view of a house at Wimbledon well illustrate this idea, and it will be seen that dining- and living-rooms and three bedrooms face south-east and open upon loggias and balconies and garden.

"Open Planning" and Construction

The placing of walls inside the house serves to separate the storage, cooking, sleeping, and toilet accommodation from the open portion. Each of these is given the most suitable shape, height, and area, and it often happens that structural devices such as cantilevers and eccentric loading are called for which involve the use of reinforced concrete. This comes about through the irregular shapes, demanded by this functional view of planning, not coinciding as between lower and upper floors, through the tendency to place windows at angles of the building where perhaps the best view or aspects can be enjoyed, and through the use of projecting balconies.

The Single Living-room

A feature common to many houses is the single living-room, intended to serve almost all the purposes usually associated with dining- and sitting-rooms, study, music-room, playroom, and workroom. This arrangement is in contrast to the one shown in the Wimbledon house,

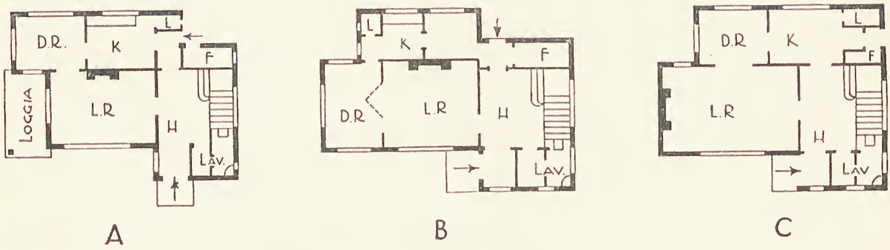


Fig. 6.—Comparison of living-room plans

A, a draughty and uncomfortable arrangement; B, a comfortable room; C, a more orthodox arrangement.

and one doubts whether it is appropriate for large families with diverse interests and habits. In any case, the single room should be really large, and of such a shape as can be used simultaneously for different purposes. For small houses, intended for families of two or three, the single living-room is usually the best solution.

An Alternative to Large Windows—the Loggia

Where the site is exposed, very large windows would make the house uncomfortably cold, and a loggia, providing as it does an open-air room, can usually be arranged in a sheltered position. This provides an alternative to large-windowed rooms for such weather conditions as prevail on cliff tops and in hilly districts.

Metal Windows

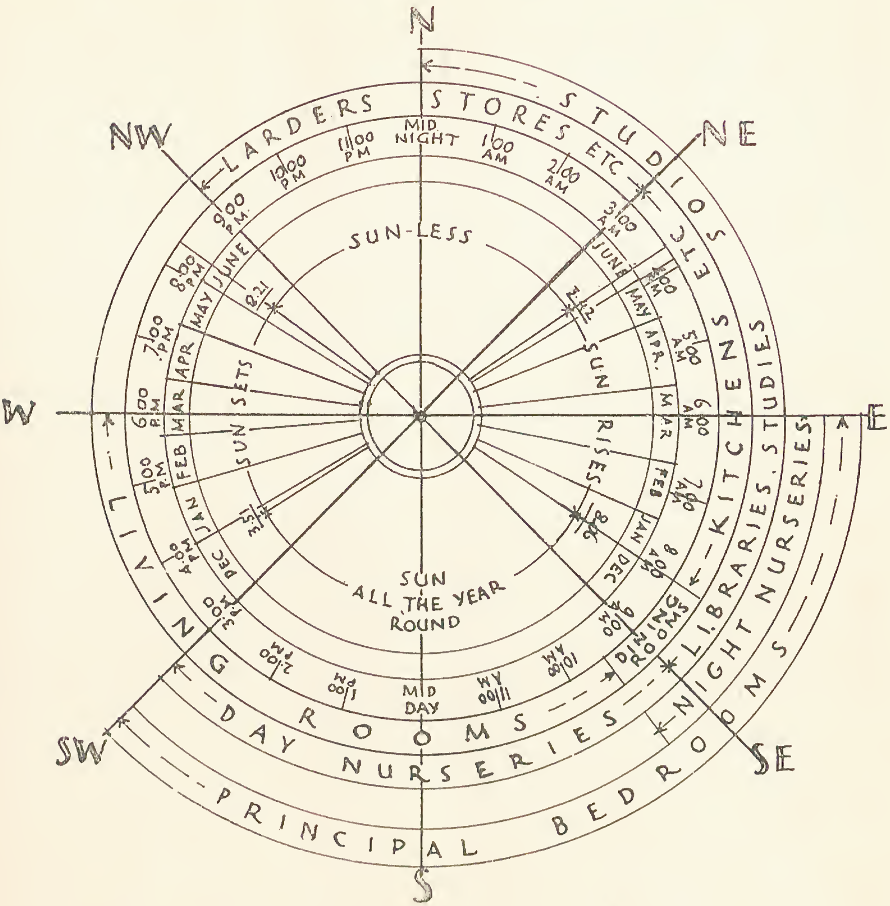
Among other requirements necessitated by modern planning is a standard metal window of a stronger section than the familiar cottage type. The large, undivided lights are at present expensive, unless they happen to be of the size of the stock metal door units. A standard sliding folding window would also be useful, and would popularise this excellent type.

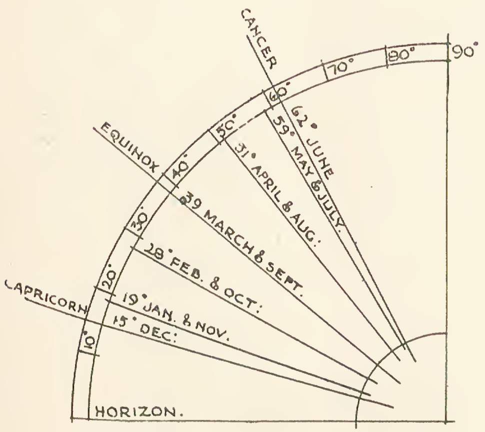
The heating problem will remain a serious one in any building with large windows, such as the house at Wimbledon, and in our climate this constitutes the most serious obstacle in the way of general recourse to open planning. In this house the problem is deftly handled by means of double glazing to the south of the living-room. Between the outer and inner windows there is provision for growing plants.

The best hopes in this direction are that the cheapening of electric supply may render adequate radiant heating of houses an economic possibility, or that some other form of central heating supplied by public utility or local authority may reduce heating cost sufficiently to make it a negligible item.

Comparison of Living-room Plans

The very simplicity of the new style makes it the more difficult to master. A simple example as to planning will make clear the importance





Figs. 7 *and* 8.—DIAGRAMS SHOWING ASPECT OF ROOMS IN RELATION TO RANGE OF SUN FOR LATITUDE 51.30 N., AND SUN ALTITUDES FOR LONDON IN N.S. ASPECT
(*By courtesy of "The Architect and Building News"*)

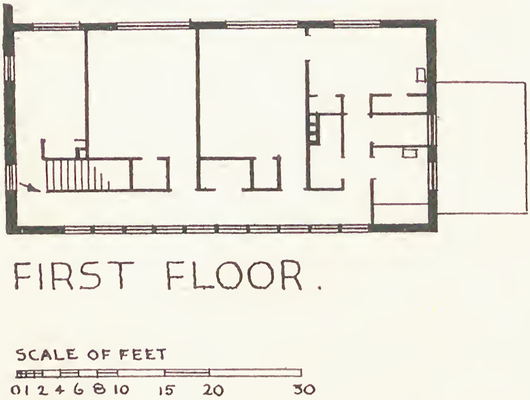


Fig. 9.—PLAN OF FIRST FLOOR OF HOUSE AT TEWIN, HERTS, SHOWING BEDROOM CORRIDOR TREATMENT
(*Architect: Mary Crowley, A.R.I.B.A.*)

of the right placing of openings and screens. One often sees plans in which the living-room has a fine long window, facing the view, running the length of the room. If, however, the entrance is at one end, and the dining-recess at the other, the only position available for the fireplace or sitting-space is the long side opposite the window. Such a position, as arranged in Plan A (Fig. 6), is, however, draughty, and being on the way to the dining-room uncomfortable for sitting in. A comfortable room is suggested in Plan B by the proper placing of the door and screen.

A more orthodox arrangement is shown in Plan C. The front door is here placed on the return wall, so that a wind check is provided by means of a vestibule. It sometimes occurs in planning that some sacrifice in comfort must be made if an unusual view is to be enjoyed to the full. If this view is to the north, it becomes all the more important to provide ample heating facilities in all exposed parts of the house, so as to minimise draughts.

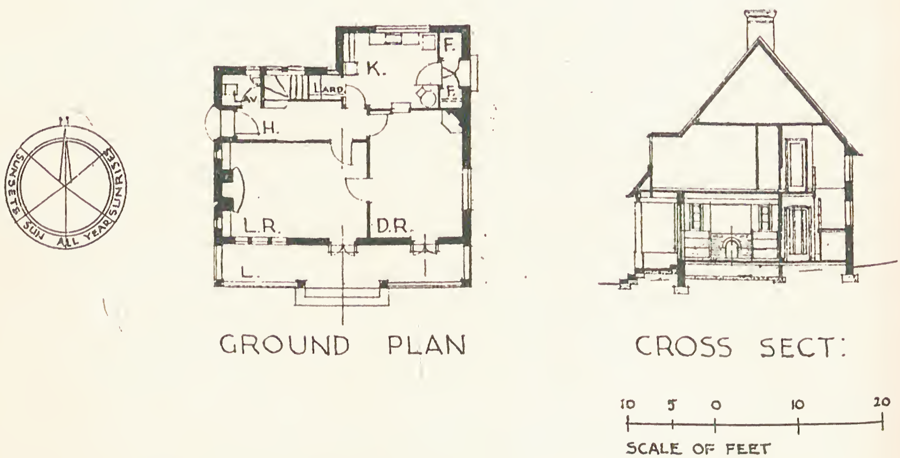


Fig. 10.—PLAN AND CROSS-SECTION OF HOUSE AT WELWYN
(*Architects: Mauger & May, A/F.R.I.B.A.*)

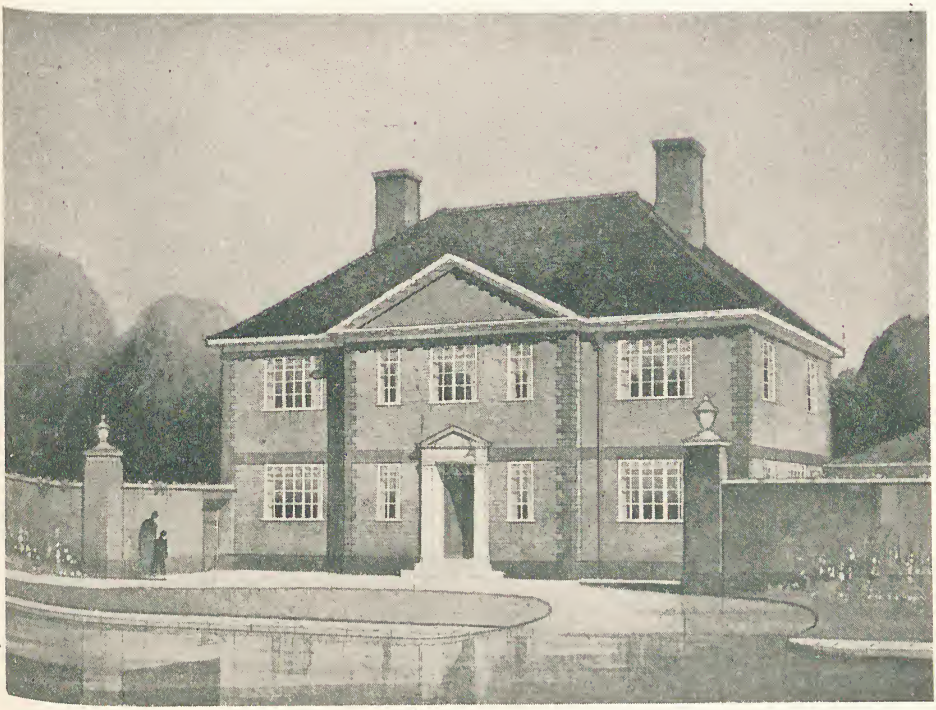


Fig. 11.—A modern Georgian detached house at Sydenham (*Architect: Fred Harrild, M.A., F.R.I.B.A.*)

Aspect and Its Influence on House Planning

The diagrams (Figs. 7, 8) indicate desirable aspects for the rooms in the private house, and the altitude of the sun at different periods of the year.

Bedroom planning, though not so much affected by new methods of planning as the rooms used by day, is equally controlled by considerations of aspect. Owing to the cheerfulness of morning sun, sleeping-rooms should face south to east, and an east bathroom will be appreciated.

A Rule with an Exception

It is generally desirable to avoid a western aspect for bedrooms, on account of the heat in such rooms at night during the summer, though when cross-ventilation can be arranged this objection may not arise. A further objection to a western aspect for children's bedrooms is that the sun may keep them awake until nearly 9.30 p.m. in the summer. Built-in cupboards of a depth of about 2 ft., fitted as wardrobes, are becoming indispensable.

The Bedroom Corridor

In a long and narrow, rather than a square, plan for four or five bedrooms, it often happens that access to them demands a corridor along

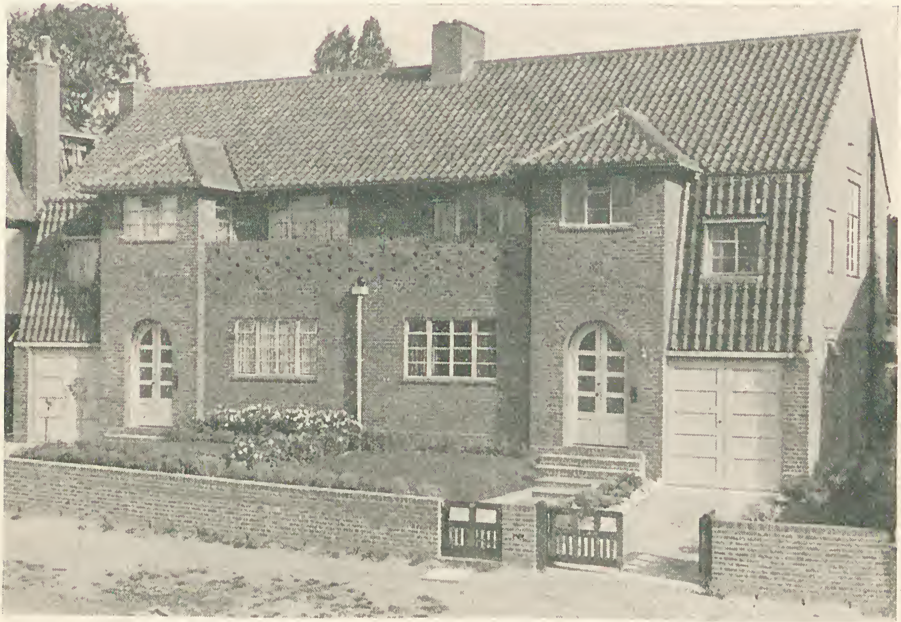


Fig. 12.—Semi-detached houses at Hampstead Garden Suburb

Showing a pair of houses on a narrow frontage, the continuous gabled roof helping to give breadth to the building. Both detached and semi-detached houses require considerable space around them if they are to have dignity. (*Architects : Mauger & May, A/F.R.I.B.A*)

the north side of the house. This is not a feature to be shunned, especially where a good view can be obtained from it. The plan, Fig. 9, of the house at Tewin, Hertfordshire, is an example of this treatment—in appearance reminiscent of the covered deck of a liner. It is to be remembered that northward views are often most attractive, on account of the fact that the landscape in that direction is often lit by the sun shining from behind the observer.

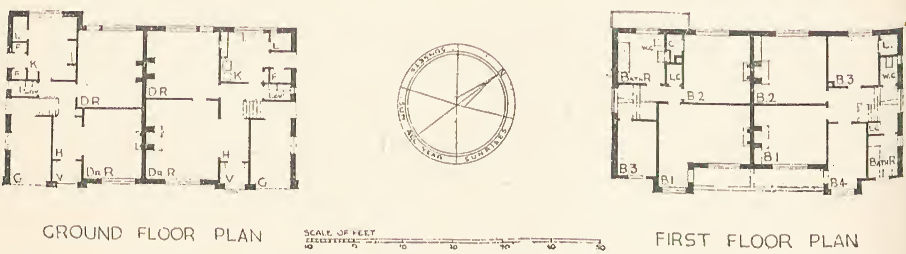


Fig. 13.—Plan of houses at Hampstead Garden Suburb
(*Architects : Mauger & May, A/F.R.I.B.A.*)

Kitchen Planning—New Ideas versus Old

Much thought has been given lately to the planning of kitchens, with the result that by placing fittings around the walls in the sequence of their normal use, both space and time may be saved. It is, however, rather against the English tradition, developed at a time when household servants were extensively employed, and when large storage and still-room space was needed for foodstuffs. These conditions no longer obtain, but such is our conservatism that many housewives still demand a large and often a far from labour-saving kitchen, pantry, larder, and scullery of the old type. The planner often tries to persuade his client to unite the kitchen and scullery by means of a wide opening in the dividing wall, at the same time arranging for a small recess at the other end, or a side alcove off the kitchen, to serve as a place for either the family's breakfast or the maid's meals.

Fig. 14.—EMPHASIS OF MAIN ENTRANCE OF HOUSE AT EAST FINCHLEY

The arched front entrance has an added dignity by reason of the gable which surmounts it. (*Architect: Frank T. Winter, A.R.I.B.A.*)

Planning for Aspect

In planning for aspect it is useful to have the points of the compass clearly marked with the angles of sunrise and sunset throughout the year,

Fig. 15.—THE EFFECT OF WIDE WINDOW OPENINGS IN A HOUSE AT JORDANS, BUCKS (*Architects: Mauger & May, A/F.R.I.B.A.*)

on the lines of the diagram given on the plans of the houses at Hampstead.

By the aid of diagrams such as those given in Figs. 7 and 8, the hours during which the sun will shine through any windows can be ascertained. On them should be indicated the direction of any view which it is desirable to command from the house.

Open Planning in Urban Surroundings

It may have occurred to readers that real open planning, with the irregular building forms it involves, is less likely to fit in with urban surroundings than does a more formal arrangement. This is generally true, though the building of small detached and semi-detached houses, of whatever type, closely packed in town streets seldom achieves good civic architecture. All such buildings require considerable space around them if they are to have dignity. The owners of small town houses can seldom afford wide sites, and in such cases continuous groups or terraces form the most satisfactory solution. The objections raised to them in these days of mechanical music and wireless can be to some extent met by providing "through" rooms from front to back, and where possible by the building of party walls 13½ in. thick, or by the fixing of floor and roof timbers with due regard to the avoidance of sound

Fig. 16.—COTTAGE AT WELWYN GARDEN CITY

Showing the north front, of unobtrusive character. (*Architects: Mauger & May, A/F.R.I.B.A.*)

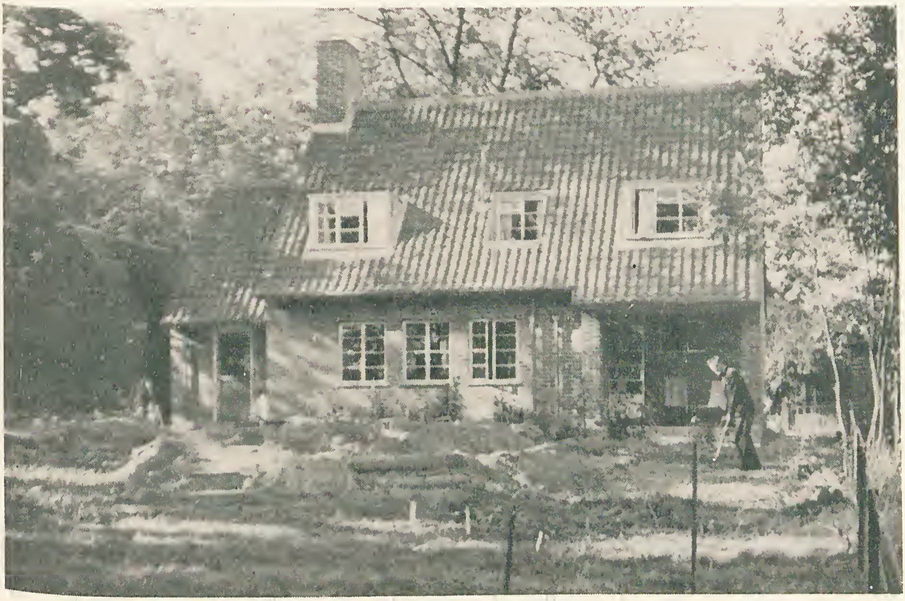


Fig. 17.—SHOWING GROUPING OF GROUND-FLOOR WINDOWS FACING SOUTH IN COTTAGE BUILT AT WELWYN GARDEN CITY

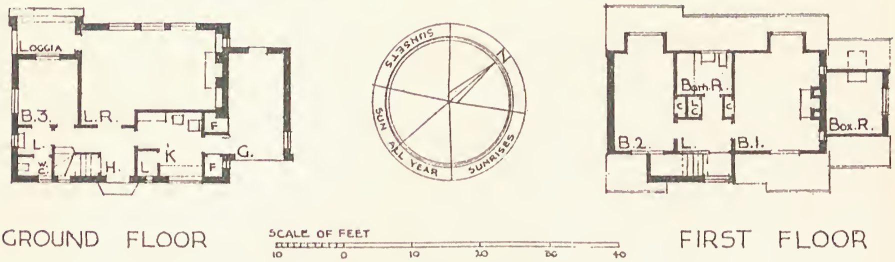


Fig. 18.—PLAN OF COTTAGE AT WELWYN GARDEN CITY
(*Architects: Mauger & May, A/F.R.I.B.A.*)

transmission across the party wall. Examples of such groups will be illustrated in a subsequent article.

When Narrow Frontages Are Unavoidable

It is evident, from the perspective of the house at Sydenham, that the modern Georgian small house requires ample space just as does the house at Wimbledon. When narrow frontages are unavoidable, owing to high ground costs or to defective road layouts which necessitate deep, narrow plots, semi-detached houses are to be preferred on grounds of æsthetics as well as of economy. The illustrations of the houses at Hampstead Garden Suburb show an attempt at suburban rather than rural character. The available frontage was only 68 ft., and to make the most of it the roof was gabled and carried in a single line throughout. The contours presented problems which were turned to some advantage by the arranging of rooms (a maid's bedroom and bathroom respectively) over the garages at a mezzanine level. The set-back of the first-floor wall made possible narrow balconies in front of the bedrooms, whence the fine south-west view can be enjoyed.

The house on the narrow frontage calls for special consideration when, as in the case of the one at Welwyn, the front faces south across a beautiful valley with woods beyond. It would have been a mistake to have sacrificed any of the south front to the entrance, particularly as the building was set well back, so that the flower garden was in front. The entrance door was placed at the west end, and living- and dining-room and loggia, and the bedrooms above, enjoy the view and the southern aspect.

DESIGN

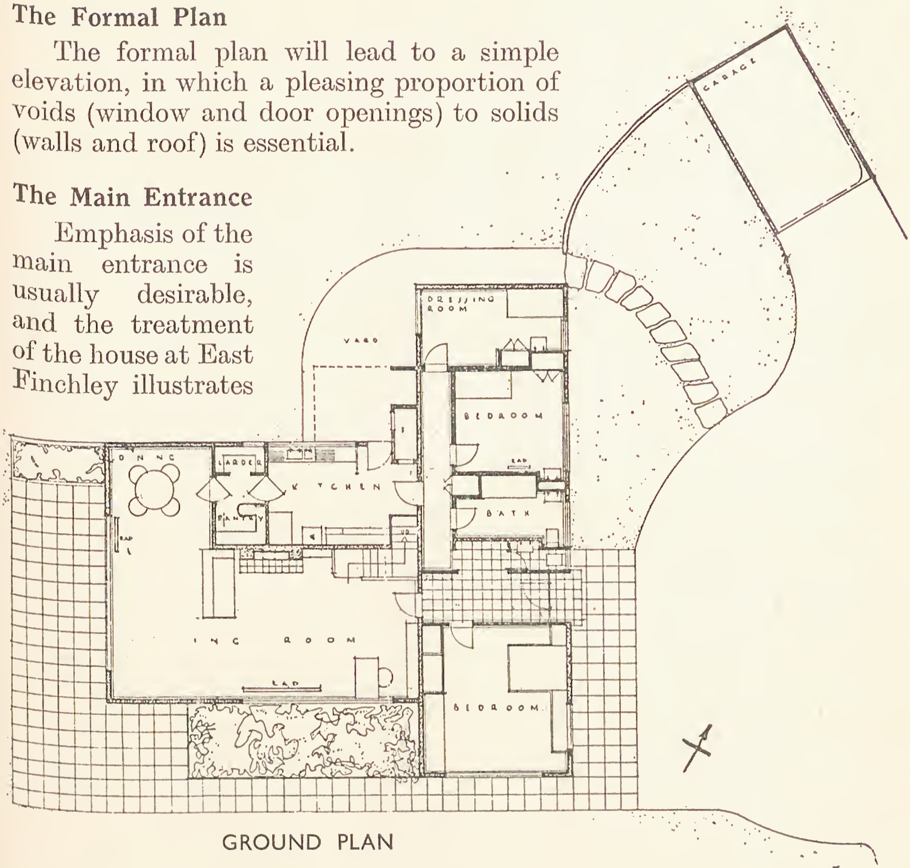
We have thus far considered the house from the point of view of planning which is fundamental to design. We are now dealing with the final " look " of the house both within and outside : that is to say, the resultant of plan and section embodied in the elevation. It is a subject calling for more space than is here available, but a few points must be put.

The Formal Plan

The formal plan will lead to a simple elevation, in which a pleasing proportion of voids (window and door openings) to solids (walls and roof) is essential.

The Main Entrance

Emphasis of the main entrance is usually desirable, and the treatment of the house at East Finchley illustrates how this may be done. Any features, such as a hood or cornice, balcony or flower-box, over the front door, and steps leading to it, are other useful means of giving prominence to the entrance.



GROUND PLAN

Fig. 19.—Plan of house at Hatfield. (*Architect : F. R. S. Yorke, A.R.I.B.A.*)

Windows

Almost limitless arrangements of windows are possible, and their treatment may be with or without horizontal or vertical glazing bars, as the general style of the building may suggest. In particular, windows must have areas and cill levels to suit the use of the room they light. A larder or bathroom, for instance, will not call for a tall double-hung sash, as is sometimes done to meet the exigencies of the modern " Georgian " manner.

It is, on the other hand, unnecessary to limit the glass area in a living-room to the sizes given in the by-laws, for with suitable aspects as much

as one-fifth of the floor area is often desirable. Flexibility of window sizes and placing is therefore necessary. This is a reason why the small modern house is often based on less formal fenestration than that dictated by the Georgian style.

Wide windows and doors help to give both a sense of space and restfulness in the rooms, and an unostentatious appearance from the outside. Where the Georgian style is adapted, the cottage rather than the mansion should be followed, as in the small house at Hampstead Garden Suburb. The house at Jordans illustrates the effect of wide openings, and the cottage at Welwyn Garden City a variant of this treatment in which two-light windows are grouped with 9-in. piers between.

The plan and view of the front of the latter show a purely cottage treatment, and it may here be pointed out that the small country house should be designed so as to be inconspicuous. It should therefore not appear to be imitating either mansion or villa.

Design of Roof

As already explained, when dealing with planning, the pitched roof imposes a certain rigidity upon the planning. There are, however, ways of roofing which enable the architect to plan to suit most requirements. Eaves levels may be varied, and the main roof be carried down to first-floor level across wide spans ; small-span roofs over entrance or garage may either abut the wall or mitre with the main roof.

In old houses, where the depth was too great to make a single span economical, two parallel roofs with a gutter between were often built, giving an M-shape in end elevation. This is not generally desirable, on account of the fallen leaves which collect in the gutter and are difficult to clear out.

The "Open Section"

Low, horizontally proportioned rooms are more conducive to a sense of restfulness than the stilted shapes of Victorian interiors. There are people, however, who require the stimulation of contrasting forms in their homes, and for them an "open section" is as important as an open plan.

THE LAW AS IT AFFECTS BUILDING PRACTICE

PART I.—USEFUL LEGAL NOTES FOR THE ARCHITECT

WHEN an architect is invited by his friend to prepare a sketch design for a proposed house, or where he is requested by a client, who is unknown to him, to submit a design for a new building, he is usually rather diffident about mentioning fees or the method of payment for two reasons : firstly, that he does not wish to appear as if putting his own affairs too much in the forefront, and, secondly, because he is not in a position to say how much work will ultimately be required of him ; the scheme may fall through, whereupon only a nominal fee will be chargeable, or, by careful management and happy circumstance, the apparently small scheme may grow into one of much greater magnitude.

The Royal Institute, however, strongly advises its members to bring to the notice of their clients, at the earliest possible moment, the recognised scale of charges[1] : to business men, and the architect should be one, this seems a reasonable proposition, and apart from the purely monetary consideration it contains a most important element, for it makes the client, in some measure, recognise that he may have conferred upon the architect powers of agency—to which reference will presently be made.

Dealing with a Corporation, Company, or Local Authority

The position outlined above concerns the private client. There is another type of client, who may be a corporation, a company, or a local authority, and in dealings with them the architect will be wise to exercise his utmost business acumen. For as Coke C.J., the great lawyer, said in 1614, "*as touching corporations they are invisible, immortal, and have no souls, and therefore no subpœna lies against them because they have no conscience.*"

Claims against Corporations

Corporations, such as a local authority, are elected by the ratepayers

[1] See R.I.B.A. conditions of engagement and scale of charges dated 1933 (amended 1935 as regards Clause I (h) only).

at periodic intervals, and it is only right that they should be masters in their own house and have immediate control of all their affairs; to facilitate this the Public Authorities Protection Act, 1893, was passed, and this provides that claims against corporations in the exercise of duties arising out of Parliamentary enactment must be brought within six months or they are statute barred.

Thus, where a quantity surveyor prepared bills for 158 houses for an urban authority in exercise of powers under the Housing of the Working Classes Act, 1890, and thereafter demanded payment; it was refused and on action being brought the surveyor was unsuccessful because he had no agreement under seal.[1]

Although recent legislation may have tempered the harshness of the case above quoted,[2] the architect, in dealing with a corporation, will be well advised to obtain a contract of service in sufficient form to enable action to be brought upon it if necessary.[3]

When Accommodation Particulars Are Given

Sometimes an architect is instructed to prepare drawings for a proposed building; no measure of cost is indicated, but certain accommodation particulars are given, and in this case no legal difficulties confront the architect.

When a Site Is Indicated

In other cases a site is indicated and the client says: "I want a building to cost x pounds and no more, including all charges": here again the architect has a straight proposition to solve, and upon the solution being presented to the client he is at liberty to say he will spend more, and gain any greater accommodation he may require.

Cost and Accommodation

The client may, however, say: "I want a building to cost not more than x pounds and to include y accommodation." Here the architect may be frank, and say at once: "You cannot have both, because y accommodation will cost z pounds more than x," or alternatively the client may accept less accommodation.

If, however, the architect elects to prepare plans and specifications, and upon tenders being received they are found to materially exceed the stipulated sum, it may be that the client has a sound defence in law to a claim by the architect for payment for services rendered on the ground that they were useless to him.[4]

[1] Nixon *v.* Erith Urban Council, [1924] 90 L.J.K.B. 756.
[2] See Local Government Act, 1933.
[3] See draft issued by R.I.B.A., prepared by W. E. Watson (contract between architect and local authority). See also *Emden's Building Contracts* (5th edition), p. 343.
[4] Moneypenny *v.* Hartland (1824), 1 C. & P. 352; (1826), 2 C. & P. 378 N.P.

A Reasonable Degree of Skill and Care

A person who exercises a profession such as that of architecture undertakes to give to his employment a reasonable degree of skill and care,[1] and he represents himself as understanding his subjects and qualified to act in the incidents committed to his charge.

The client buys both skill and judgment, and an architect ought not to undertake a commission if he cannot bring it to a successful issue, apart from such occasions where the client may elect to supersede the judgment of the architect by imposing his own.

An architect is bound to exercise only such reasonable care and skill as would normally be given by his confrères ; he is not bound to possess a superlative degree of knowledge, and the fact that some other might have used greater skill does not necessarily connote negligence ; the question is whether there has been such a lack of competent skill and care leading to a bad result as to constitute negligence.[2]

The responsibility of an architect to his client to exercise care and skill is limited in so far that it is not required where he exercises duties of a quasi-arbitrator, because then he has to exercise judicial qualities of mind so as to hold the scales equally balanced as between the client and the contractor, and in this guise he is not responsible in negligence.[3]

The Architect's Responsibility

The employment of an architect is in the nature of a personal contract, and he cannot delegate his duties ; it might be more accurate to say he cannot delegate his responsibilities, because he may employ assistants and make use of the skill and labour of others, but he is responsible for the acts and defaults of his subordinates at all times and upon all occasions. Even where a clerk of works is employed by the client, such employment may not lessen or detract from the responsibilities and consequent liabilities of the architect as regards superintendence of the building works.[4]

A legal case may illustrate this proposition :—

B employed L, an architect, to superintend the rebuilding of premises after a fire. B appointed C clerk of works, and C thought that certain beams did not require to be replaced, whereupon, without inspecting them, L adopted C's view. In the event the beams proved to be inefficient. Cave J. charged the jury that the question whether new beams were required was one for the architect and not one for the clerk of works, therefore the responsibility was upon L, even if he adopted C's view without inspecting the beams.[5]

[1] Lanphier *v.* Phipos (1838), 8 C. & P. per Tindal C.J. at p. 479.
[2] Rich *v.* Pierpont (1862), 3 F. & F. 35.
[3] Chambers *v.* Goldthorpe, [1901] 1 K.B. 624 C.A.
[4] Saunders *v.* Broadstairs Local Board (1890), Hudson 4th Ed. II, 164. Leicester Guardians *v.* Trollope, [1911] Hudson 4th Ed. II, 419.
[5] Lee *v.* Bateman, [1893], *The Times*, Oct. 31st.

Rescission of the Contract

A contract of employment of an architect, being personal in its nature, is determined by the death of either party, although a claim by or against trustees or personal representatives may survive. Similarly, prolonged illness or disablement of an architect may usurp his employment, and this is a point which frequently arises where no provision has been made to meet it ; it does give to the client an opportunity for rescission of the contract where the balance of convenience may be in his favour, but where there is a partnership agreement involving more than one principal, the balance of convenience may be a continuance of an existing arrangement.[1]

It sometimes happens that a client becomes dissatisfied with his architect; similarly, it sometimes happens that an architect is anxious to have done with his employer. The most recent conditions of engagement and scale of charges [2] provide that an architect may dismiss himself from a commission, but previously this was not so, and if an architect dismissed himself he was probably creating a rod to his back in the way of allegations of lack of care amounting to negligence.

The employer, on the other hand, has always been able, if so minded, to dismiss his architect as his agent, and at any moment either with or without good cause, and the architect's remedy lies in an action for damages.[3]

Powers of the Architect

The architect may have power, either direct or implied, before a building contract is signed, to act as the agent of the client; but when the contract is signed and the architect is therein designated, his powers are more generally recognised and particularly by the contractor, subcontractors, and merchants.

He has no implied authority to order as extras such items as are necessary to complete the contract except as provided for in the contract, and to exercise this power without authority or knowledge of the client may, in the event, embarrass him considerably. The architect has, further, no implied authority to warrant his drawings as being accurate, and if he fraudulently does so to the prejudice of the contractor the employer may be liable in respect of them, despite any clause in the contract or specification which purports to put the contractor upon his guard.[4]

Changing the Designs

In actual practice, the architect frequently takes the greatest liberties in amending and improving his design for the benefit of his client, usually

[1] See Philips *v.* Hull Alhambra Palace Co., [1901] 1 K.B. 59.
[2] See R.I.B.A. scales of charges, etc., dated 1933.
[3] Hickey *v.* Brown (1842), 4 Irish L.R. 277.
[4] Pearson (S.) & Son Ltd. *v.* Dublin Corporation, [1907] A.C. 351.

by way of detail and further explanatory drawings; "to change one's mind is but to say 'I am more wise to-day than yesterday,'" and on this principle the architect gives better service than he probably would if he adhered strictly to his original conception; nevertheless, the point emerges that the prudent architect will be wise to keep his client closely in touch with proposed variations in order to avoid any possible regrettable developments in a later stage.

As the standard contract form [1] provides that the architect may order any variations, either by way of extra or omission, he does so in guise of agent of the employer, and although the contract form requires that orders should be in writing, or confirmed back by the contractor in writing undisputed,[2] the architect is at liberty to allow in his final certificate for any extras not earlier formally placed upon record, and the employer is bound by the architect's certificate, if it has honestly been given, subject, of course, to the provisions of the arbitration clause of the contract.[3]

The Arbitration Clause

The arbitration clause of the standard contract (No. 26) is given in two forms, and each permits of the insertion of the name of a selected arbitrator, but supposing he cannot act, the clauses have different provisions. A provides that the contractor may, from two names given by the President of the R.I.B.A., select one; whereas form B provides for direct nomination by the President. The arbitrator, however appointed, may review the incidents referred to his judgment, but so long as the architect acts strictly within the scope of his appointment as agent of the employer he can incur no personal liability for his acts to the contractor.[4]

When the architect is, by the terms of a contract, empowered to give decisions in a quasi-judicial capacity (as, for instance, under the clauses which, by the arbitration clause of the contract, are excluded from a reference to arbitration),[5] the employer has no right to prevent him acting; and although he may terminate or repudiate his employment as his agent, still the architect is free to exercise his judicial function, and the employer may not dispute his decisions.[6]

When an Architect Acts without Due Care and Skill

When an architect acts without due care and skill, either in designing or in supervising the erection of buildings, his employer is entitled to dismiss him,[7] whereupon the architect may forfeit either wholly or in part any right to remuneration because, as has above been stated, a person

[1] See R.I.B.A. contract forms dated 1931.
[2] See Clause 1 of contract form.
[3] See Clause 26 of contract form.
[4] Ramsden & Carr *v.* Chessum & Sons & Ward, [1913] 110 L.T. 274.
[5] See R.I.B.A. form dated 1931, Clause 26 (b).
[6] Mills *v.* Bayley (1863), 2 H. & C. 36.
[7] Harmer *v.* Cornelius (1858), 5 C.B. (N.S.) 236.

who purports to be skilled in any profession cannot recover for services which are useless or which, by the exercise of reason, he ought to have known would be useless for the particular purpose whereon he was employed.

The legal proposition goes even further than this, and if the negligence or want of skill in the architect is so severe as to occasion loss or detriment to the employer he may be liable in damages,[1] and the amount of them is measured by the actual loss to the employer, without regard to the amount of fees payable.[2]

The question may arise in one's mind as to what does amount to "want of skill," the term "due care" being in itself obvious. Tindal C.J. in 1833 [3] stated what, to his mind, was a fair test, and that was: "What would experienced confrères have done in the same given conditions?" it being recognised that ignorance and unskilfulness in any particular, contrary to the established principles of that art or science as recognised by the universality of the profession concerned, may amount to negligence.

For instance, an architect was alleged to have been unskilful in preparing bills and measuring up where an error of $\frac{3}{4}$ per cent. in a contract of £10,000 was found; this was held not to be so serious as to prejudice his claim for payment.[4]

How Much of the Law Should the Architect Know?

An architect is not expected to have an accurate and minute knowledge of law, but he might reasonably be expected to have such a general knowledge of building law as would avoid embarrassment to his employer.[5]

Building Law

The building law may be that of either public or private statutes, such as Public Health Acts or Building Acts; and common law rights such as refer to easements—the duty to know the law probably applies with greater force when new statutes changing the general law come into operation, and these have been many during the last few years.

The architect also has to regard the law with respect to neighbouring buildings, such as restrictions with regard to the development of property. The employer owes a duty to his neighbour not to infringe his rights, and he may not so delegate the execution of building works as to relieve himself from responsibility.

The architect in such cases may not be fully acquainted with legal niceties, but he should be so aware of general propositions as either to advise the obtaining of legal advice or to ask authority from his client to employ legal aid and guidance.

[1] Leicester Guardians *v.* Trollope, [1911] Hudson 4th Ed. II, 419.
[2] Saunders *v.* Broadstairs Local Board (1890), *supra.*
[3] Chapman *v.* Walton (1833), 10 Bing. 57.
[4] Corbett *v.* Richmond (1888), *Building News*, May 18th.
[5] See Hopkins *v.* Smethwick Local Board (1890), 59 L.J.Q.B. 250.

Thus, in a case arising under the London Building Act regarding a party wall, the Court held that an agreement made was beyond the scope of the architect's authority, and defendants were ordered to disconnect their building from the party wall.[1]

Party-wall Awards

It is usual in party-wall awards made under the London Building Act, 1930, Part IX, to insert a clause whereby permission is given for the building owner and his workmen to enter upon the premises of the adjoining owner to perform works; this clause gives a licence for the workmen to enter, whereas without it they would be, in law, mere trespassers; in such a case the engineer to the employer was held responsible.[2] It may be that damages will have to be proved arising out of the trespass, otherwise it may be regarded as purely a technical point; nevertheless the purpose of such a clause in an award may be of consequence.

Sometimes a clause is inserted in a specification providing that the works are to be properly executed notwithstanding any defects in the drawings or specification, and such a provision is generally intended to prevent a disingenuous contractor from formulating a wrongful claim; still, the clause may not be good enough to avoid allegations of negligence against the architect by the employer even although he may also be at liberty to join issue with the contractor.[3]

Examination of Site

If an architect fails to exercise reasonable care in an examination of the site whereon buildings are to be erected, when he is put on his guard, he may be liable as to knowledge of the strata as regards foundations, rights of way, easements of light and such like, so that if his plans are defective or impracticable he may be liable to the employer provided he can prove some degree of detriment.[4]

Thus, where an architect was employed to prepare plans and have quantities obtained, and he did not measure the site, but acted on outside information, which made out the site to be smaller than, in fact, it was, when the error was discovered the employers sued the architect for recovery of fees paid or alternatively for damages in negligence, and it was held that the employers were entitled to a verdict in their favour.[5]

Liability due to Defective or Incomplete Plans and Specifications

Plans and specifications may render an architect liable through their being defective or incomplete, or through their not being supplied to the contractor in proper season sufficient to enable him to make use of them; a negative liability may also arise; as for instance, where an architect claimed fees for designing a conversion of a house into flats, where he

[1] Betts (Frederick) Ltd. *v.* Pickfords Ltd., [1906] 2 Ch. 87.
[2] Monks *v.* Dillon (1882), 10 L.R. Irish 349.
[3] See Brown *v.* Laurie (1854), 5 L.C.R. 65.
[4] Moneypenny *v.* Hartland (1824), 1 C. & P. 352; (1826), 2 C. & P. 378 N.P.
[5] Columbus Co. *v.* Clowes, [1903] 1 K.B. 244.

negotiated for purchase, and it evolved that permission to convert was not obtainable, he failed in his claim [1] for remuneration.

A design may in itself be defective or incomplete as not being in accordance with the art or science of architecture, or being opposed to recognised principles of construction; secondly, as not being in accordance with definite instructions of the client; thirdly, as contravening statutes or by-laws; and, fourthly, as disregarding restrictions imposed on the use of land either by statute, common law, or contract.

On the other hand, it is the duty of the skilful and prudent architect to go near to the margin of safety in his client's interest, and in some cases even to overstep the boundary.

For instance, in a light and air case, where, by keeping close to the margin of safety on the architect's advice, an owner was found liable for a nominal payment in satisfaction of a claim against him, but had obtained considerably greater floor area in his building: the architect, far from being liable, was to be commended for his skill and foresight, and if the owner had cared to take legal remedy against him because he had to pay nominal damages, he could not prove any such, commensurate with the benefit he had received.

A mere approval by the employer of plans submitted to him will not exonerate the architect from liability if the design is not in strict accord with instructions given, or if the design is structurally defective.[2]

The measure of damages where a design proves impracticable or valueless will depend on whether the work is commenced before the defects are discovered; presumably the remuneration of the architect will always be in jeopardy, and in addition any other losses occasioned to the client, including, it may be, the contractor's claim for loss of anticipated profit.

Failure to provide plans or delay in handing them to the contractor may entitle him to repudiate the contract as to time for completion by a specified date, and penalties for non-completion may have to be abandoned, giving rise to a claim by the employer against the architect,[3] and a claim may include loss of interest on capital or loss of rent or profit.[4]

Supervision

It cannot reasonably be expected that an architect should constantly be on the building works to supervise every item of building progress, yet he is required to devote such an amount of time to the work as is commensurate with an honest certificate that the work has, or has not, been performed in full satisfaction of the terms of the contract.

The Architect's Certificate

Failure to discover materials or work not performed as specified before the builder goes free under the date of the final certificate may involve the

[1] Mason *v.* Brookes, [1927] *Estates Gazette Digest*, 92.
[2] Smith *v.* Barton (1866), 15 L.T. 294.
[3] Hadley *v.* Baxendale (1854), 9 Exch. 341.
[4] The Marpesa, [1906] 94 L.T. 428.

employer in a loss which he can saddle upon no one but the architect, and the amount of such loss may be the value of the rectification of defects.[1]

When an architect certifies in a quasi-judicial capacity he cannot be impugned, but otherwise, should he certify without skill commensurate to the task, or negligently, as, for instance, overestimating the value of progress or interim certificates, he may become liable because owing to incidents supervening and beyond his control an interim certificate may not be capable of adjustment in the final accounts, where bankruptcy or some other cause determines the contract before its final satisfaction.

This point is illustrated by a case where engineers in the employ of a local board certified due and satisfactory completion of a drainage contract and also certified for the value of work done. On trial they were found liable for the amount over-certified, and the liability was not limited to the amount of their professional charges.[2]

In a building contract the architect's certificate is considered as final, subject, of course, to the terms of the contract, as between the employer and the contractor, but not as between the employer and the architect.

Thus, where an architect was employed to design and superintend the erection of a house, and under the terms of the contract the architect's decision was to be final as between the parties to the contract. The architect, in the event, certified finally and thereafter brought action to recover his fees; the employer counterclaimed in negligence in supervision, and the architect contended that he had taken certain defects into his consideration before he certified and had deducted a sum in respect of them. The jury decided in favour of the employer, notwithstanding the alleged consideration given in the certificate.[3]

The crux of the above case seems to be that the issues arose upon a certificate which purported to be final, because in a more recent case[4] where a housing authority was required to use materials which the Disposals Board had for sale, the architect issued interim certificates in favour of the builder and advice notes in favour of the Disposals Board; in the event the authority overpaid and alleged negligence against the architect but failed to substantiate it.

CERTIFICATES

The cases previously referred to on the subject of certificates may well lead to a short digression upon their nature, and the responsibilities of an architect in respect of them.

They may, in a general sense, be described as safeguards to the em-

1 Re Trent & Humber Co. *ex parte* Cambrian Steam Packet Co. (1868), 4 Ch. App. 112.
2 Saunders & Collard *v.* Broadstairs (1890), Hudson 4th Ed. II, 164.
3 Rogers *v.* James, [1891] 56 J.P. 277.
4 Wisbech R.D. Council *v.* Ward, [1928] 2 K.B. 1.

ployer's interests issued by one who is his duly accredited agent, and who looks to him and to him alone for remuneration for his services.

The approval of work done by the contractor, whether stated in a positive or a negative form, is expressed by certification in recognised formulæ, and the issue of such certificates may or may not be conditions precedent to payment by the employer to the contractor. Suffice it to say they form frequently the starting-point for adjudication by an arbitrator under the normal contract forms.

The architect may in some cases find that it devolves upon him to certify that the works could reasonably have been completed within a certain time, alternatively that the time for completion of the contract works and extra works has been extended to a named date so that the contractor may know that the damages clause of the contract is still in operation.

In this connection a contractor agreed in his contract to £3 per day as liquidated damages, any amount due to be deducted from moneys payable. The employers sought to deduct £873 under the contract, but the contractor claimed that extensive alterations and additions abrogated the provisions of the clause ; the time, however, had not been extended, and the contractor having bound himself to complete within a certain time was liable even although it involved his performing an impossibility.[1]

The Question of Additional Work

It would seem, therefore, to devolve on the architect to inform the contractor, when ordering additional work or extensive variations, whether he is to have further time in which to complete the whole works or whether he is expected by the employment of extra labour to complete within the original contract period.

This information would put the contractor on his guard and give him opportunity to elect whether he will accept the work on the proposed condition or claim an abrogation of the damages clause of the contract, or refuse to accept the extra work.

The architect may make use of the work of others in collecting information necessary to enable him to certify, but the certificate is his, and the responsibility for it devolves on him alone.[2]

The usual method of certification is that value is allowed less a certain percentage which accumulates till it reaches, say, 20 per cent. of the contract sum. This retention fund is held as security for the performance of certain incidents which may arise : thereafter payment is certified to full value.

When possession is taken of the premises, that is, when they are practically completed, half the retention sum is released, and upon the expiration of the period of maintenance (usually six months), when defects

[1] Jones *v.* S. John's College, Oxford (1870), L.R. 6 Q.B. 115.
[2] Clemence *v.* Clarke (1879), Hudson 4th Ed. II, 54.

arising from faulty materials and workmanship are made good, the remaining 10 per cent. is certified, whereafter the contractor is normally legally freed from any liability in respect of the works.

Progress Certificates

The Institute contract forms provide that the " progress " certificates shall not be considered as a final adjudication of value from time to time, and in this respect no certificate shall be considered as final except that one which purports to be final ; in other words, the progress certificates are merely convenient contributions to the funds of the contractor to enable him, without embarrassment, to complete the whole work[1] ; the withholding of these convenient contributions may, however, become, in essence, a breach of the contract.

Final Certificate

A final certificate may be something akin to an award in so far as it represents a judicial function of the architect as between the parties, and in the issue of it the architect combines his duties as agent of the employer with his fairmindedness as between contractor and employer, but he must ever have in mind that dissatisfaction in the contractor has its proper outlet in a reference to arbitration under the ultimate clause of the contract.

In certain cases, even although the architect is not an arbitrator, in certifying finally he may find it convenient, in order to prevent a dispute arising, to hear formally any observations the contractor has to make on certain items, and in such cases he should exercise his judgment as to whether he should give the employer opportunity to be present and answer to the observations of the contractor as well as to raise any other matters which may be cogent to the contract.

It is usual for the contract to provide that the issue of a certificate is a condition precedent to a right by the contractor to claim payment from the employer,[2] and therefore, where nothing is considered due by the architect, it may devolve upon him to certify negatively, so as to avoid a breach of the contract which requires that certificates shall be issued at certain dates.

The onus is on the contractor to obtain from the architect a certificate on which his right to payment depends,[3] and if the employer interferes with the certifier, to prevent or delay the rightful issue of a certificate, it may amount to breach of the contract.[4]

It has, in fact, been held that if the certifier wrongfully and unreasonably refuses or delays to certify, and the employer takes advantage of the

1 See Tharsis Sulphur & Copper Co. *v.* McElroy (1878), 3 App. Cas. 1040. Lord Hatherley at p. 1045.
2 Wallace *v.* Brandon & Byshottles U.D.C., [1903] Hudson 4th Ed. II, 362 C.A.
3 Glenn *v.* Leith (1853), 1 C.L.R. 569.
4 Brunsdon *v.* Beresford (1883), 1 Cab. & El. 125 N.P.

refusal to delay payment, the contractor can recover without a certificate.[1]

The issue by the architect of a final certificate not only shows that a sum of money is due to the contractor, but it also connotes an expression of opinion that the works have been performed to his entire satisfaction; this must be reasonable and not capricious.

For instance, where a contract provided that no certificate should in any circumstances cover or relieve the contractor from his liability for any fraud, default, or wilful deviation from the contract and the works described in the drawings and specification until four years from completion, it was held: to prove breach of this condition it was necessary to show that deliberate and substantial variations had been made with the object of benefiting the contractor or saving his pocket, i.e. something in the nature of what was popularly known as "scamping the work." [2]

A progress certificate, however, is not sufficient to constitute an acceptance of the quality of workmanship and materials; it is merely a kind of qualified approval, which does not prevent the employer from subsequently disputing the quality nor the architect from subsequently refusing to certify his satisfaction.

Thus, where a contractor agreed to erect buildings to the entire satisfaction of an architect, with progress certificates and balance on final certificate that the work had been executed in accordance with the contract. It subsequently appeared that work had not been done in a sound and workmanlike manner, and the final certificate was withheld. The contractor alleged fraud, and it was held that the withholding of the certificate was not a fraud on the contractor, even although the architect had given progress certificates to enable the contractor to obtain money on account.[3]

A certificate, whether interim or final, may be said to possess some of the qualities of a negotiable instrument, and on this basis it cannot be withdrawn,[4] except by agreement, but in the case of bankruptcy even a withdrawal by agreement may raise important issues.

Certificates in Favour of Sub-contractors

The above observations are based chiefly upon certificates in favour of the general contractor, but the architect may, in certain cases, elect to certify in favour of sub-contractors. Under the standard contract form he is empowered to do so where the general contractor fails to produce evidence that earlier certificates have been duly honoured; there is no duty cast by the contract upon the architect to do so, and if he elects to protect sub-contractors by certifying in their favour on the general

[1] Moser *v.* S. Magnus & S. Margaret (Church Wardens) (1795), 6 Term Rep. 716.

[2] London School Board *v.* Johnson, [1891] Hudson 4th Ed. II, 176. Robins *v.* Goddard, [1905] 1 K.B. 294.

[3] Cooper *v.* Uttoxeter Burial Board (1864), 11 L.T. 565.

[4] Davey *v.* Gravesend Corpn., [1903] 67 J.P. 127.

contractor, the certificate should be in sufficiently ample form that it may, if necessary, be a sound basis for an action in the Courts.

A mere letter saying a stated sum has been included in his favour in a certificate issued to the general contractor may not be sufficient to form a sound basis for an action.

A formal certificate can be sued upon, and in cases of impending bankruptcy it may preserve, to the particular sub-contractor who has been duly nominated by the architect, a fuller degree of payment than he would receive by ranking as an ordinary creditor of the estate.

PART II.—USEFUL LEGAL NOTES FOR THE BUILDER

A GENERAL contractor has many items and incidents to consider during the course of an important contract apart from the difficulties concerned with labour and the purchase of materials.

Many of these items and incidents are involved in and about the time which it will take to perform the contract works; when a tender was submitted the estimator probably put down so many weeks with a sanguine belief that if the contract was obtained some incident would arise to warrant cancellation of the time clause with its appurtenant ascertained and liquidated damages: it sometimes happens, however, that time in completion is of more consequence to the building owner than mere money and a higher tender may be accepted because a shorter period is required to complete the works.

When Time Is "Of the Essence of a Contract"

If a building owner stipulates that time will be "of the essence of the contract," and there is no clause in the contract or specification to mitigate this condition, the contractor must complete within the given period before he can recover payment, and if he fails to do so the consideration for payment has gone.[1]

A contractor might reasonably hesitate before he entered upon such an unpromising type of contract, but at common law time was always of the essence of the contract until tempered by Equity. To-day it may be said that building contracts are usually expected to be completed within a reasonable time and the standard forms[2] of contract while stating a time for completion also provide for damages in favour of the building owner in case the contractor does not find it convenient to complete within the stipulated period.

[1] Munro *v.* Butt (1858), 8 E. & B. 738.
[2] R.I.B.A. forms of contract dated 1931.

Damages for Non-completion Within Time Limit

Ascertained and liquidated damages are a genuine pre-estimate of damage which will accrue to the building owner if the contractor does not adhere to his bargain and are as much the subject of a covenant to be enforced as is that of the employer to honour the certificates issued by the architect.

The Penalty Clause

In this respect liquidated damages differ from penalty which, in essence, is a terrorisation of the offending party. Whereas penalty may be out of all proportion to the profit gained as to be considered harsh and unconscionable in comparison with the greatest loss that could conceivably be proved as flowing from the breach, liquidated damages are free from obscurity, are determined by agreement, and while not being excessive are deemed to be adequate to the injury contemplated.

When Damages May Not Be Enforced

Liquidated damages must run from a definite and defined date which usually is stated in the contract form, and if there is no provision therein for the substitution of a further date, owing to unforeseen circumstances, the power to enforce the damages may have gone [1]; similarly if there is a provision that extras may be ordered and they are ordered in such manner as to delay completion, unless the contractor has agreed to perform the whole works within the original time the right to liquidated damages may also have gone.[2]

How Extras Affect the Time Clause

Much, of course, depends upon the exact terms of the particular contract but, speaking generally, if extras are ordered of sufficient magnitude to require an extension of time the onus may be upon the contractor to definitely request an extension of time or an abrogation of the damages clause.

If an Extension Is Necessary See that You Get It

For instance, where a contractor undertook to execute works when the architect had power to extend the time proportionate to the extra works ordered, extras were ordered but the time was not extended, and it was held that the contractor was bound to complete within the specified time and was liable to pay the stipulated damages.[3]

Extension Refused—Contractor Liable

In another case the contractor requested the architect to extend the time as per the contract but the architect did not do so until after a

[1] Westwood *v.* Secretary of State for India in Council (1863), 1 New Rep. 262.
[2] Dodd *v.* Churton, [1897] 1 Q.B. 562.
[3] Jew *v.* Newbold-on-Avon U.D.S. Board (1884), 1 Cab. & El. 260.

writ had been issued. The architect then certified for the amount of the writ, qualifying the certificate "subject to the question of penalties." He then extended the time to a date short of the actual completion and certified that damages were due to the employer. The contractor sought to adduce evidence to prove that the causes of delay rested upon the employer and the architect but the evidence was refused by an official Referee; he held that the contractor had applied for an extension of time and that the architect had decided the matter wherein he had jurisdiction under the contract. An appeal to the Divisional Court confirmed this judgment.[1]

Interesting Observations on an Important Case

The crux of the above case apparently was that the contractor requested an extension of time long after the incidents giving occasion for it had passed, in fact just before the issue of the writ. Phillimore J. made some interesting observations when giving judgment in the Divisional Court; he said:—

> "It may, and one knows constantly does, happen in building contracts of great complexity and magnitude, that the matter arranges itself in this way. First the builder gets behind and vastly behind. Then some instruction which naturally is not given in detail, some order which naturally is not issued till the works have reached a certain stage, some supply of an article which would only be knocked about and injured if it were on the works before people are ready for it, is delayed.
>
> "It is useless to give a builder an order for something till he has got to a certain stage in his work. Probably the order has been kept back because until the building has reached a certain stage it is not quite certain what form that order had best take, certainly it is undesirable to send some delicate piece of work to lie about the works until it is really wanted.
>
> "Therefore it comes about that an architect actually does give very late, possibly after the original date for completion, an order for something which was in the original contract, but it would be perfectly inequitable for the builder to say:—
>
> "'I was bound to complete by the 30th May. You never sent me an order for the ornamental top of the chimney till the 30th June and therefore I am entitled to say that all the provisions as to delay do not apply.'
>
> "The architect or employer could reply:—
>
> "'Yes, the proper time to give you that order was, say, one month before the completion of the works, but you were six months behind at that time; therefore it was only natural that I did not give you that order then.'

[1] Sattin *v.* Poole, [1901] 2 Hudsons B.C., 4th Ed. II, 306 D.C.

"Those are exactly matters that do constantly arise as we know in contracts of this kind and it is in order that the architect may be able to deal sensibly, as a business man dealing with business matters, that these affairs are remitted to him.

"Upon the whole, therefore, I come to the conclusion that the learned Referee was right in refusing to hear this evidence, secondly that the certificate of the architect was within his powers under the contract and was final and conclusive both as to extension of time and as to the date when the works could reasonably have been completed."

Cases in Which the Builder Wins

When, however, the employer or the architect as his agent commits a breach which goes to the root of the whole contract a right to damages may be abrogated.

Possession of Premises

Thus, for instance, where an employer failed to give possession of the premises for four weeks in a contract to take four months he could not enforce the damages clause of the contract.[1]

Failure to Supply Materials—

Failure to supply materials by the employer may also waive the right to damages.[2]

—or Plans Within Reasonable Time

Where a contractor fails to complete in time owing to the architect's delay in issuing necessary plans the employer is not entitled to take advantage of his agent's wrong and determine the contract.[3]

Where the Contractor May Sue for Damages

Where a contractor tenders for what he considers a summer contract as regards weather, and possession of the site is postponed so long as to make it a winter contract, the penalty clause may not only be abrogated but the contractor also be further entitled to damages for breach of the contract.[4]

[1] Holme *v.* Guppy (1838), 3 M. & W. 387.
[2] MacIntosh *v.* Midland Counties Railway (1845), 14 M. & W. 548.
[3] Roberts *v.* Bury Improvement Commrs. (1870), L.R. 5 C.P. 310.
[4] Freeman & Son *v.* Hensler, Hudson 4th Ed. II, 292, C.A.

PART III.—USEFUL LEGAL NOTES FOR THE BUILDER (Contd.)

WHERE it is not a stipulated term of a contract that the contractor may forthwith proceed with the whole of a contract such a term may by evidence be imported into it, for instance where a contractor agreed to supply 150 tons of girders according to agreed plans and 14 tons were immediately ordered; delivery was requested four months later and further plans were given with an order for 60 tons, whereupon the contractor repudiated the whole contract.

It was held that the contract was "entire" and as plans for the whole 150 tons had not been furnished within a reasonable time the employer could not recover for the non-delivery of the 14 tons for which plans *had* been delivered within a reasonable time.[1]

When an architect certifies finally and takes no cognisance of damages under the delay clause of the contract it may be deemed that a right to deduct them has gone,[2] or in other words that the architect has extended the contract time so that the clause is rendered ineffective.

An Interesting Point re Possession of Site

It has been stated above that failure to give possession of the site may render the damages clause of no avail, but the contractor may go further and establish breaches of contract so that there may be damages due from the employer to the contractor.

During a contract for alterations and additions to a house the contractor was delayed by incidents including non-delivery of drawings and details. He claimed damages to which the employer denied liability and counter-claimed for delays.

The time for completion had been extended by the architect and was further extended in arbitration proceedings to the date of actual completion but it was held that this extension did not preclude the contractor's claim for breaches of contract in failure to give possession of the site and by interference with execution of the work.[3]

The Contractor Should Not Undertake the Impossible

Although some of the cases above referred to may illustrate that an employer cannot, as a matter of course, establish a right to damages for delay, a cogent point not altogether dissociated from the problem is that a duty, in all cases, devolves upon the contractor to exercise his judgment or to make inquiries so as to satisfy himself before he embarks on the venture that he can bring it to a successful issue, because where

[1] Kingdom *v.* Cox (1848), 5 C.B. 522.
[2] Laidlaw *v.* Hastings Pier Co. (1874), 2 Hudson 4th Ed. II, 13.
[3] Trollope & Colls *v.* Singer, Hudson 4th Ed. I, 849.

a prospective employer invites tenders for an entire contract he does not enter into an implied warranty that the work can be successfully executed from the drawings and specifications supplied. The contractor, therefore, cannot sustain an action in warranty should the venture prove a failure.

An Example

For instance, where a bridge was to be demolished and a new one erected in its stead, the particulars were stated " to be believed to be correct " but tenderers were put upon their guard to make examination for themselves. After proceeding upon the basis outlined it was found to be impracticable and much material and labour were lost. The contractor sought to be compensated but as there was no warranty of an express nature none could be implied into the contract.[1]

Another

In another case contractors bargained to construct and deliver before an agreed date a railway. The certificate of the employer's engineer was to be conclusive as between the parties. The contractors claimed that the works entailed greater labour than the documents provided for but they failed to establish their claim.[2]

In this case James L.J. said: " It would be a singular hardship upon the shareholders—almost a fraud upon them—if they found when they had taken shares in a company based on this guarantee (that is, the contractors' contract to do this work for a lump sum) that they were compelled to pay something entirely different."

" Extras "—A Thorny Question

The thorny question of " extras " is one which frequently arises in building contracts.

Where the contract is " entire " in its nature or " lump sum " for the performance of a specified building the contract is assumed to include every item necessary to produce the bargained result—even flooring boards which had been omitted from the specification.[3]

To specify, therefore, in the preamble clause that a contract is intended to be " entire " or " lump sum " is to put the person tendering on his guard that every item necessary to produce the completed whole has to be priced.

The most customary method to-day is, however, to insert a clause providing that no extras will be allowed for in the final account unless they have been ordered in some form of writing which purports to be " an order for an extra."[4]

[1] Thorn *v.* London Corporation (1876), 1 App. Cas. 120.
[2] Sharpe *v.* San Paulo Ry. Coy. (1873), L.R. 8 Ch. 597.
[3] Williams *v.* Fitzmaurice (1858), 3 H. & N. 844.
[4] Compare Clauses 1 and 10 of R.I.B.A. contract form.

What Are Extras?

A mere variation may constitute an extra from the contractor's standpoint, for the work may be so far advanced that a simple variation entails extra cost and lost labour, but the word has in a measure been judicially construed as to designate all works (or labours) not expressly or impliedly described in the specification and drawings (and contract).

It appears to be a question of fact for the tribunal (arbitrator or Judge) to decide in the case of a written contract whether additional work is of the kind contemplated by the contract or outside and independent of it.[1]

Powers of Agency

In earlier days, the powers of agency conferred upon an architect by the contract form were much more limited than they are by the forms in normal use to-day, and an onus lay on the contractor who made a claim to establish the authority of the architect to give the order.[2]

By the 1931 standard forms, however, the employer deputes to his architect, and also to the quantity surveyor, very comprehensive powers, and if the contractor can establish his orders to be in proper and ample form, he is on much safer ground than under the old common law forms of contract.

Lump-sum Contracts

In a lump-sum contract the employer may not be liable :—

(1) For work impliedly necessary for completion of the whole.

(2) For work performed voluntarily without request.[3]

(3) For work as to which conditions precedent prescribed in the contract have not been complied with, except, of course, where an arbitration clause overrides the conditions precedent.[4]

(4) For work ordered by the architect beyond the scope of his authority ; and

(5) For work which lies outside the contract or any implication thereof.

"To the Satisfaction of the Architect"

Beyond the safeguard as to cost, from the employer's point of view, by making the contract "lump sum," there is a further safeguard by specifying that the work is to be to the satisfaction of a third party, the architect, and in obtaining this satisfaction there can be involved no claim to extra payment if all the items are for work necessary to complete the whole.[5]

[1] Russell *v.* Sa Da Bandeira (Viscount) (1862), 13 C.B. (N.S.) 149.
[2] R. *v.* Peto (1826), I. 7 & J. 37.
[3] Wilmot *v.* Smith (1828), 3 C. & P. 453.
[4] Brodie *v.* Cardiff Corpn., [1919] A.C. 337.
[5] Dobson *v.* Hudson (1857), I.C.B. (N.S.) 652.

When " Extras " May Be Added to a Lump-sum Contract

When, however, an architect has power to give a final and binding certificate it is conclusive as between the parties even although it may direct payment for work as extras which is really comprised in the work contracted for, or for extras not ordered in the stipulated manner.[1]

Additional Work and " Extras "—a Distinction

If additional work is of such a nature as to be entirely outside the contract, it may not come within an order for extras so as to make it subservient to the stipulations of the contract, but if the contractor accepts the order " as for extras," he may be estopped from denying that the burdens of the contract apply to it.

Work which is ordered after the completion of a contract may, on that ground, be entirely outside it and form the basis of a separate claim for materials and labour free from any restriction contained in the contract.[2]

Where, by a contract under seal, a contractor undertook to do work for a fixed price, and later alleged that the work had been so essentially varied that he was entitled to claim payment on the basis of cost under an implied new contract, it was held that he could not repudiate the original contract subject to such adjustments for prices as seemed equitable.[3]

A Restriction of the Architect's Powers

A power to order alterations or extras will not be so extended as to permit the architect to change the essential character of the work, and thereby obtain something entirely different from that of the original conception.[4]

Lord Kenyon's Ruling

The contract may be followed, so far as it is possible to do so—the question is one of comparative degree; but when it becomes impossible to trace the provisions of the contract it may be abandoned, and an implied contract superimposed to pay by measure and value, or by some other equitable method, and on this Lord Kenyon laid down a guiding rule.[5]

> " Where some additions are made to a building which a workman contracts to finish for a certain sum of money, the contract shall exist so far as it can be traced to have been followed, and the excess only paid for according to the usual rate of charging . . . if a man contracts to work by a certain plan, and that plan is so entirely abandoned that it becomes impossible to trace the contract and to

[1] Lawson *v.* Wallasey Local Board (1883), 11 Q.B.D. 229. Roberts *v.* Bury Commrs., L.R. 5 C.P. 310.

[2] Russell *v.* Sa Da Bandeira (*supra*).

[3] Bell *v.* Bridlington Corpn., [1908] 72 J.P. 453.

[4] R. *v.* Peto (1826), *supra.*

[5] Pepper *v.* Burland (1792), Peake N.P. 103, 104.

say to what part of it the work shall be applied, in such a case the workman shall be permitted to charge for the whole work done by measure and value, as if no contract at all had ever been made."

Defects Arising After Completion

Occasionally trouble arises out of the contract clause which requires defects arising within an agreed period to be made good. The employer sometimes seems to think that whenever some minor trouble arises he has only to ask the architect to see to it, and the architect in turn merely notifies the contractor, happily expecting that the trouble will disappear and be forgotten.

From the point of view of cultivating cordial business relationship, the procedure outlined above may be a sound investment for the contractor.

On the legal side the normal contract clause is limited to defects, shrinkage, or other defects . . . due to materials or workmanship not in accordance with the contract, or to the effect of frost.

The extent of the contract obligation, therefore, is exclusive of wear and tear requirements.

There is a power in the standard contract that where a contractor fails to make good defects of which notice has been given, the employer may employ other persons to perform the work, and set off the price paid against any moneys due or to become due to the contractor.

In such cases it devolves upon the employer to expend the moneys as if he were somewhat in the guise of a trustee, using the utmost care and circumspection in dealing with the moneys of another.

An Important Point to Remember

It should be remembered that no liability can usually be saddled upon the contractor for unskilful design or for the shortcomings of materials properly used if they are fully specified.[1]

The procedure above outlined is that of the 1931 forms of contract, but other forms are extensively used, whereby other conditions are imposed.

Deviations from the Standard Contract, 1931

For instance, sometimes a general condition is inserted which requires the contractor to keep the whole works in repair for a fixed period ; repair means good, substantial repair, and in an ordinary commercial contract may connote a greater allowance in tendering than for the provisions of the standard contract.

Again, one occasionally finds a "maintaining and upholding" condition which may be considerably more onerous in degree than mere repair.

[1] Makin *v.* Watkinson (1870), L.R. 6 Exch. 25.

For example, where such a clause was specified a contractor was required to rebuild a bridge broken down by extraordinary flood.[1]

It is worthy of notice that not only essentials, but also useful or reasonable ameliorations, are not excluded by such terms.[2]

Time Limit to Right of Action

The right of action on breach of a covenant either to remedy defects or to maintain or repair is a continuing one throughout the prescribed period, and the date of expiration is a mere limitation date beyond which usually no legal demand can be made.[3]

If Contractor Refuses to Remedy Defects

If a contractor has declared that he will not remedy defects or execute repairs, it may be that he will be liable to be charged with the cost of executing them on the analogy of a case concerning a lease.

In that case A let premises to B and covenanted to rebuild after notice. A subsequently told B that he would not rebuild, whereupon B rebuilt without notice, and it was held that A was liable in damages for not rebuilding.[4]

Generally, however, notice is required, and the method in which it is to be given is described in the contract.[5]

Sub-contractors Nominated by the Architect

In important building contracts many items are committed to the charge of sub-contractors. Where a sub-contractor is nominated or appointed by the architect, it may be that he will exercise powers given to him by the standard contract, and protect the sub-contractor's interests as against those of the general contractor, even going so far as to certify in his favour direct upon the employer. This power is one of election, and there is no compulsion upon the architect to exercise it.

The Standard Sub-contract Form (1935)

The new standard sub-contract form[6] incorporates the provisions of the standard form of building contract,[7] and a sub-contractor is deemed to have knowledge of its contents, but the provisions of the sub-contract which may be repugnant to the main contract are to prevail.

[1] Brecknock *v.* Abergavenny Canal Co. (1796), 6 Term Ref. 750.

[2] Sevenoaks & Maidstone Ry. *v.* L.C. & Dover Ry. (1879), 11 Ch. 625–634 per Jessel M. R.

[3] Luxmore *v.* Robson (1818), 1 B. & Ald. 584.

[4] Johnstone *v.* Milling (1885), 2 T.L.R. 105.

[5] L. & S.W. Ry. Co. *v.* Flaver (1875), 1 C.P.D. 77.

[6] See standard form of Building Sub-contract (1935), issued under sanction of National Federation of Building Trades Employers and National Federation of Specialists and Sub-contractors.

[7] See standard form of Building Contract (1931), issued under sanction of the R.I.B.A. and National Federation of Building Trades Employers.

The "Privity of Contract" Clause

A most important provision in the main contract is that there is to be no privity of contract as between the building owner and a sub-contractor. This means that it may, in cases of bankruptcy, have far-reaching effects.

It may also be said that where this clause (No. 15B) has been omitted, the effects may in another direction be equally far-reaching.

Thus, where a contractor ordered goods in his own name to a value of £95 from a sub-contractor, the architect increased the order to £137. The contractor became bankrupt, and the architect, on receiving an indemnity, certified £95 to the sub-contractor. The trustee in bankruptcy refused to accept a certificate for the difference between the two sums, and sought to obtain £137 by motion for an order directing the architect to certify in favour of the bankrupt's estate. Held. The County Court judge had power to make such an order and should have exercised it.[1]

It has been contended that where a power to certify in favour of sub-contractors exists in a contract, something in the nature of a trust is created in their favour, but the argument was held to have no substance.[2]

If the Main Contractor Becomes Bankrupt, Sub-contractors Have Prior Claim

Where a power to certify direct in favour of sub-contractors exists in a contract, and the general contractor by bankruptcy or by an act of bankruptcy causes undue delay in payment of sub-contractors, the bankruptcy does not annul the power of the certifier, as is sometimes popularly presumed, and it has been decided that the claimants may take priority over other creditors.[3]

As the stipulations of the contract may vary, so the contractual capacity of the parties may differ; in some cases a liability may lie upon the building owner, and in others on the contractor, as to whether the latter is acting as a *bona fide* agent of the former or whether he is acting as a principal.

Where a builder contracted to erect a school under a lump-sum contract, and it contained a provisional item for heating apparatus, the heating sub-contract was accepted by the builder on the architect's instructions, and in due course an instalment on account was paid, but the builder was unable to pay the balance. The sub-contractor sued the employer, and it was held that the builder ordered as principal and not as agent of the employer, therefore the action failed.[4]

Owner *versus* Contractor

It occasionally happens that an astute building owner, by ordering his sub-contract or merchant items direct, and not through the agency of the

[1] Re Holt, *ex parte* Grey (1888), 58 L.J.Q.B. 5 D.C.
[2] Leslie *v.* Met. Asylums District (Managers of), [1901] 68 J.P. 86.
[3] Re Wilkinson *ex parte* Fowler, [1905] 2 K.B. 713.
[4] Hampton *v.* Glamorgan C. Council, [1917] A.C. 13.

contractor, endeavours, sometimes successfully, to evade a profit which normally goes under the standard forms of contract to the contractor.

The very fact of doing so may, in given circumstances, make any claims arising thereunder due as against the employer as distinct from the contractor.

A Loophole for the Contractor

It may also give certain obvious loopholes to the contractor in breach of contract, otherwise the mere fact that a sub-contractor or a specialist employed by a contractor confers the benefit of some materials or labour upon the employer, does not necessarily give rise to " privity of contract " between the sub-contractor or specialist and the employer sufficient to enable a successful claim direct upon him to pay for such benefit.

In one case, where a contractor undertook to construct a railway complete with stations, etc., and subsequently sublet parts of the work, it was held that as the sub-contractors originally looked to the contractor for their payments, and there was no evidence that the employer authorised the contractor to employ these special sub-contractors, there was no " privity of contract " between them and the employer. In the event the sub-contractors could not enforce any claim against him.[1]

When the Architect Deals Directly with Sub-contractors

Negotiations and direct dealings between an architect, as agent of the employer, and a sub-contractor, may in some circumstances be helpful to the latter should he seek to establish a privity of contract to the exclusion of the general contractor, provided such dealings are not contrary to the provisions of the contract.

The contract, in cases of dispute, will be construed within its four corners to the exclusion of dealings prior to its signature, and although it may be said that the sub-contractor is not a party to it he will probably be a signatory to the standard sub-contract which incorporates the provisions of the main contract, nevertheless specific orders to a specialist or sub-contractor in full legal form may constitute a contract independent to or overriding the provisions of the main contract.

Probably the most decisive factor in case of dispute depends on the question as to who gave the order to the sub-contractor, the architect as agent of the employer or the general contractor. Thus, where a contractor placed the order he could not take advantage of delays by the sub-contractor to bring a claim for delays against the employer.[2]

On the other hand, where under a lump-sum contract the payments arising under " provisional sums " were to be certified by the architect upon either the employer or the contractor, and in one case the contractor

[1] Colonial Government *v.* Smith (1886), 4 Juta. Cape. Ref. 194.

[2] Leslie & Co., Ltd. *v.* Managers of the Met. Asylums District, [1901] 68 J.P. 86 C.A.

had placed the order, but the architect certified upon the employer, and it was held he was liable.[1]

When the Employer May Evade Liability

The employer being usually a mere layman in respect to building matters, and probably even less than that in respect of the legal matters akin to building, he must perforce be guided by his architect, or his legal advisers, in respect of most matters arising under the contract ; if the architect places orders under the contract he commits his employer to their value, but where he places orders outside the contract, the employer may evade a responsibility on the ground of limitation of authority and the architect may himself be found liable.

A Case in Point

Thus, where an architect failed to disclose that he was acting as agent in placing an order, it was held that by making the contract in his own name without naming his principals and expressly excluding his liability, he had rendered himself liable. Further, the sub-contractors by endeavouring first to obtain payment (on certificates) from the employer and the contractor, had made no election exonerating the architect.[2]

Another Example

In another case the architect told the contractors that goods were ordered under the contract ; they were duly delivered, but the contractors endeavoured to evade responsibility for their payment. Action was brought against them, and it was held as the goods had been delivered and used by the contractors, an implied promise by them to pay for the goods should be inferred.[3]

Lien upon Works

In some forms of contract a general contractor may have a lien upon the works until the contract is satisfied by payment ; similarly a sub-contractor may have some security for ultimate payment, but apart from such provisions a sub-contractor retains the property in his materials until they are actually delivered to the contractor or, as the case may be, embodied into the contract works ; thus where contractor agreed to provide tanks which would not become fixtures on the purchaser's premises, he employed a sub-contractor to erect them, who brought action when the contractor became insolvent, and it was held that no property in the tanks so far as erected had passed, and on completion plaintiff (the sub-contractor) would not be bound to hand them over except upon receipt of payment or security on first charge.[4]

[1] Hobbs *v.* Turner, [1902] 18 T.L.R. 235 C.A.
[2] Beigtheil and Young *v.* Stewart, [1900] 16 T.L.R. 177.
[3] Ramsden & Carr *v.* Chessum & Sons & Ward, [1913] 110 L.T. 274.
[4] Bellamy *v.* Davey, [1891] 3 Ch. 540.

The above case may be no sufficient authority to entitle a sub-contractor to claim a lien or charge on money due to the general contractor in respect of sub-contract work, nor is such a general proposition of law.[1]

If a contractor sublets portions of the contract works, and retains others for his own performance, he binds himself that none of his own acts or defaults will prevent the sub-contractors from having opportunity to complete their portions. He may not take advantage of his own default as regards the contract to defeat or prejudice the rights of sub-contractors; thus, where a railway contractor sublet part of the contract works, and agreed to pay out of moneys certified by the engineer, the sub-contractor completed his work, but as the general contractor defaulted, no money became payable to him. Held that the general contractor was liable to the sub-contractor.[2]

PART IV.—DILAPIDATIONS

THE word "dilapidations" immediately connotes a relationship of landlord and tenant in some form or other. Renovations to one's own buildings may be called dilapidations in so far as they are the result of neglect, but the word "repairs" more accurately designates them, because whereas dilapidations may and usually do entail legal consequences, mere repair to one's own premises entails none beyond a general duty to one's neighbours and the passer-by in the street—the duty covered by the legal maxim "*Sic utere tuo ut alienum non lædas*"—"So use your own property as not to injure the rights of another."

Dilapidations are considered to be those defects which have arisen from neglect or misuse, it being a presumption of English law that at the commencement of the term the tenant was satisfied that every detail of the buildings was in a substantial state of repair.

To What Extent Is a Tenant Bound to Repair?

The onus is therefore put upon a tenant either to satisfy himself, or by expert advice to ascertain, that the buildings when he takes them over are in a perfect condition of repair, or alternatively, to have an agreed schedule of existing defects prepared as a shield against unreasonable demands by the landlord as the term proceeds to its close.

A tenant who accepts a repairing covenant in his lease is not bound to repair to such a degree as to give his landlord a new building in place of one which by age or inherent defect is unrepairable. For instance, where, owing to a house being originally built on a timber platform on waterlogged soil, it became necessary (on a dangerous-structure notice) to support the house entirely anew by walls carried down to a gravel

[1] Pritchett and Gold & Electric Power Storage Co. *v.* Currie, [1916] 2 Ch. 515 C.A.
[2] McBrien *v.* Shanley (1874), 24 Up. Can. C.P. 28.

foundation, the tenant was held not to be liable, as the work would result not in a repaired house on a timber platform, but in a new house on a new foundation.[1]

Repairing Covenants

An accepted proposition is, that if a tenant takes a house which is of such kind that by its own inherent nature it will in course of time fall into a particular condition, the effects of that result are not within the tenant's covenant to repair.[2]

Thus, where a drain is unsuitable and the local authority constructs a new one, the cost should not be a burden on the tenant under his covenant to repair drains,[3] because he is only bound to keep the existing drain in repair.

But while a tenant is not bound under a repairing covenant to improve the building so as to give the landlord something different from that which he demised, yet he must do such repairs as are suitable for the building, having due regard to its age and class ; for instance, the degree of repair may be different in Grosvenor Square and Spitalfields,[4] and he must replace any parts, including floors, roof, or external walls, which become defective or dangerous owing to the lapse of time or the effect of the elements.[5] Thus, where a lessee covenanted to well and substantially repair and keep in thorough repair and condition and so deliver the premises at the end of the term, and the front wall had failed by natural decay, sufficient to be the subject of a dangerous-structure notice, the lessee was held liable to pull down and rebuild.

Liability of Landlord to Repair

Repairing covenants may vary in degree of stringency ; whether they are reasonable or harsh and unconscionable is a matter for consideration before the lease is signed, and the architect may be called upon to advise as to whether they should be revised, it being remembered that, as a general proposition, and in the absence of express stipulation or a statutory duty,[6] the landlord is under no liability to put demised premises into repair at the commencement of a tenancy, nor to do repairs during the period of the tenancy, whether the letting is for a term of years or from year to year; and the fact that the tenant has agreed to repair "fair wear and tear excepted,"[7] or "damage by fire and tempest" excepted,[8] does not imply a covenant by the landlord to make such "fair wear and tear" or damage good.

[1] Lister *v.* Lane and Hesham, [1893] 2 Q.B. 212 C.A.
[2] Wright *v.* Lawson, [1903] 68 J.P. 34.
[3] Lyon *v.* Greenhav, [1892] 8 T.L.R. 457.
[4] Proudfoot *v.* Hart (1890), 25 Q.B.D. 42.
[5] Lurcott *v.* Wakeley and Wheeler, [1911] 1 K.B. 905 C.A.
[6] For instance, see the Housing Act, 1925, 15 Geo. V, ch. 14, sect. 1.
[7] Arden *v.* Pullen (1842), 10 M. & W. 321.
[8] Weigall *v.* Waters (1795), 6 Term Rep. 488.

Nor does the fact that he remains in control or possession of part of the premises, as, for instance, a main staircase, affect the application of the above rule, so that he is not liable to keep the staircase in repair so as to render the demised part habitable.[1]

The principle that premises are not, apart from express stipulation or statute, warranted fit for habitation, applies to an unfurnished flat as it does to a house, and should the premises be found unfit the tenant cannot allege a breach of implied warranty, as a ground entitling him to damages or rescission of the lease.[2]

The intending tenant is presumed to make his own investigation as to the condition of the premises, and in the absence of special stipulation or statutory protection he takes the premises as they stand[3]; thus, apart from fraud or fraudulent representation, there is no law against letting a tumble-down house,[4] and the mere omission by the landlord to disclose defects within his knowledge is not an active deceit.[5]

If the contract of tenancy, however, is still executory and the premises are found to be bug-infested or otherwise dangerous to health and uninhabitable, it will not be enforced.[6]

Warranty as to Fitness

A warranty by the landlord at or before the making of a lease that a house is in a fit state for habitation as regards repair, drainage, or any other matter, may be given as an express contract or may be implied from representation as to the state of the house; the kernel of the matter is whether the facts disclosed are intended to be the basis of the contractual relationship, and breach of the contract sufficient to warrant rescission or damages. Such a warranty may be oral or in writing and is a collateral to the lease, but if the lease is signed an oral statement made afterwards will not vary its terms.[7]

Liability to the Public

Premises when severely out of repair may constitute a nuisance, and if a person is injured in passing, *prima facie* the tenant or occupier is liable for the injury[8]; further, his liability is not lessened by the employment of competent contractors to do repairs even if the injury is caused by their neglect.[9]

[1] Colebeck *v.* Girdlers Coy. (1876), 1 Q.B.D. 234.
[2] Cruse *v.* Mount, [1933] Ch. 278.
[3] Chapel *v.* Gregory (1863), 34 Beav. 250.
[4] Robbins *v.* Jones (1863), 15 C.B. (*N.S.*) 221, 240.
[5] Keats *v.* Cadogan (Earl), (1851), 10 C.B. 591.
[6] Chester *v.* Pavell, Pavell *v.* Chester (1885), 52 L.T. 722. Sub-proceedings 1 T.L.R. 390 C.A.
[7] De Larsale *v.* Guildford, [1901] 2 K.B. 215, 222 C.A.
[8] Payne *v.* Rogers (1794), 2 Hy. Bl. 350.
[9] Jarry *v.* Ashton (1876), 1 Q.B.D. 314.

If the landlord has covenanted to do repairs he will be liable, and to avoid circuity of action he may be directly proceeded against, since the tenant if found liable would have a remedy over against the landlord.[1]

It is, however, a condition precedent to a tenant's right of recovering damages for the landlord's breach, that the landlord should have had notice or actual knowledge of the defects whether latent or patent.[2] When he has such notice he is responsible not only for permanent repair but also for immediate temporary security.[3]

For instance, where a lessor covenanted to keep the exterior of premises in good and substantial repair, and the tenant wrote on 2nd April telling the lessor that "steps to the front door want attention"; thereupon the lessor employed a contractor to do the necessary repairs and these were completed on 16th April—on the 14th April, while the lessee was leaving the house, unaware that the steps were in a dangerous condition, they collapsed and he fell through into the cellar beneath, sustaining severe injury: In an action by the lessee for breach of covenant to repair, it was held that the letter of 2nd April was sufficient notice, and damages were recoverable.[4]

Liability to Neighbours

In the performance of dilapidation works it must not be forgotten that, while a general duty not to injure the public arises, there is a particular one due to neighbours not to injure their buildings, and the employment of competent contractors will not lessen the liability; for instance, where an owner employed a contractor to rebuild, which entailed the endangering of the support of a neighbouring house, and deputed all risks to the contractor: Damage was done to the neighbour's property and he obtained damages [5] against the owner.

Conditions by Landlord

It sometimes happens that a landlord covenants to put premises into an improved state of repair before the tenancy commences or early in its duration, and the complete performance of such a covenant is essential before the tenant can be held liable for any repairs [6] or breach of covenant except one, that is, the payment of rent; a covenant to pay rent and one to repair are independent of each other, and a breach of one is no defence to a claim in respect of a breach of the other.[7] It has been established

[1] Payne *v.* Rogers (*supra*).
[2] Morgan *v.* Liverpool Corpn., [1927] 2 K.B. 131.
[3] Griffin *v.* Pillett, [1926] 1 K.B. 17.
[4] Griffin *v.* Pillett (*supra*).
[5] Baver *v.* Peate (1876), 1 Q.B.D. 321.
[6] Slater *v.* Stone (1622), Cro. Jac. 645.
[7] Taylor *v.* Webb, 2 S.E. L.R. 763.

that a tenant must continue to pay rent although the premises are burnt down, unless there is an express covenant that rent shall cease.[1]

Express Contract to Repair

Leases of property usually contain a covenant by the tenant to repair and keep in repair the demised premises during the term, and another covenant, which is distinct, to repair specific defects within a certain period (usually three months) after receipt of a schedule of defects; there is usually a further covenant which provides for the handing over of the premises at the expiration of the term in substantial repair. The usual forms of lease contain a covenant for re-entry upon breach of any covenant, but sometimes it is limited to damages by way of compensation as visualised by the Law of Property Act, 1925, sect. 146, which also puts the onus for the legal expenses and costs of the lessor's surveyor upon the tenant.

To Keep in Repair

A covenant to repair and keep in repair during the term means *at all times during the term*, and if the premises are out of repair at any time the lessee has in fact committed a breach of covenant, for which the lessor can recover damages commensurate to the injury; with the same covenant it would likewise be a breach if the lessee altered the structure in any way, or even opened a new door or window in one of the walls without licence.

Where the character of a neighbourhood changes, that which was once a gentleman's residence may become a series of small flats, and in an important case[2] the effect of the covenants on a 99 years' lease was held to be not limited to such repairs as would satisfy the requirements of reasonably minded persons of the class then likely to become occupiers of the premises.

Valuation of Dilapidations

A landlord, apart from covenant or licence granted, has no legal right to enter upon demised premises to view their condition, because for any unauthorised entry he would be liable in trespass.

At the end of the term, if no licence is granted, the landlord's surveyor enters to ascertain what defects exist, according to the stringency of the covenants and their legal consequences. He may put a value against each item with a view to a monetary settlement as distinct from the actual execution of the repairs, it being remembered that no damage shall be recovered if the premises are to be pulled down or materially altered[3] in such a way as to render the repairs valueless. It is also to be

[1] Hare *v.* Groves, 3 Anstr. 687.
[2] Calthorpe *v.* McOscar, [1924] 1 K.B. 716, 93 L.J.K.B. 273 C.A.
[3] See Landlord & Tenant Act, 1927 (17 & 18 Geo. V, ch 36), sect 18 (i).

remembered that damages for breach of repair covenants shall in no case exceed the amount (if any) by which the value of the reversion (whether immediate or not) in the premises is diminished owing to the breach of the covenant.[1]

Thus, it may be that the Court will ascertain the actual value of the property in an unrepaired state as distinct from its value if repaired, and the difference between these two sums may be a fair measure of the depreciation to the reversion.[2]

It may, however, depend upon how far off the reversion is ; in a case recently tried E was tenant of part of certain premises under a lease for a term of 98 years, and he sublet that part to B for the unexpired residue of that term less the last 15 days. E's superior landlord then let to B, for a term of 999 years, the whole of the premises subject to E's interest in the part. B, in breach of a covenant in his sub-lease, made considerable structural alterations to the whole of the premises, which B used for the purpose of running an hotel. E brought an action against B for breach of the conditions in the sub-lease.

The County Court Judge awarded E £60 damages, which he assessed on the basis of the restoration work which would have to be done to that part of the premises in which E had an interest before E could let that part to some other person. B appealed, and it was held : (1) the proper measure of damages was the diminution in the value of E's reversion due to B's breach of covenant, and not the cost of restoring the premises ; (2) as B was entitled to possession of the whole of the premises for 999 years apart from E's reversion of part for 15 days, and B had acquired possession of the whole of the premises for the unitary purpose of running an hotel, there was no evidence of diminution in the value of E's reversion, and E was entitled only to nominal damages.[3]

Internal Decorative Repairs

After a notice is served on a lessee relating to internal decorative repair he has, if it is harsh and unconscionable, some redress under the Law of Property Act, 1925, sect. 147. This entitles him to apply to the Court for relief, and the Court may, by order, wholly or partially relieve the lessee from liability, but this relief does not extend to abrogation of express stipulations as to decorative repair, sanitary or structural conditions, or to statutory liabilities, or to covenants to yield up in a stipulated state at the end of a term.

Non-user of Premises

Where a landlord has not opportunity to issue a dilapidation schedule until after the term of the lease has expired, it is obvious that there may

[1] See Landlord and Tenant Act, 1927 (17 & 18 Geo. V, ch. 36), sect. 18 (i).
[2] Hanson *v.* Newman, [1934] Ch. 298.
[3] Espir and others *v.* Basil Street Hotel, 3 A.E. L.R. page 91.

be a period elapsing, without beneficial occupation either to the tenant or to the landlord, while repairs are being carried out, so that there may be an onus on the tenant to deliver the premises up in strict accord with the covenants if he seeks to protect his own pocket. Thus, where an arbitrator adjudicated between a landlord and lessee, the former claimed compensation for non-user of the premises, and the Court confirmed him in his claim.[1]

Degree of Repair

As a general proposition, under an agreement to keep premises in good tenantable repair, and so leave them at the expiration of the term, the tenant's obligation is to put and maintain them in such repair as, having regard to their locality, age, and character, would make them reasonably fit for occupation by a tenant of the class who would be likely to take them, but as improvement in the character of a neighbourhood cannot appreciate the degree of repair required, neither should the deterioration of a neighbourhood lessen the degree of repair.[2]

A tenant who agrees to keep premises in good tenantable repair is not generally excused from doing so by reason of the fact that they were not in such condition at the time of the demise; thus, if it is obvious that painted woodwork will decay unless it is repainted, the onus is on the tenant to do it, and in such a manner as is consistent with the class of the property: that for the Mayfair mansion is different from the small house in Spitalfields, and the landlord's requirements in the former district might well vary from those of a reasonably minded landlord in the latter.[3]

If a substantial item, such as a floor, is rotten when the tenancy began, the tenant is obliged to repair it; if it has gone beyond repair he must replace it.

Form of Repairs Schedule

In schedules of dilapidations there is a more or less standard form for setting forth the details. They usually begin with external items such as roof, front elevation, side and rear elevations, followed by outbuildings, paved courts, garden and garden structures, boundary walls and fences, etc. The internal items usually begin on the top floor front, top floor side, top floor rear, top floor side and staircase, and so on from floor to floor downwards.

It is prudent to take rough dimensions of each room or item, so that if necessary there is ample data whereon to base prices of valuation, and in the contingency be prepared for strenuous cross-examination.

[1] Birch *v.* Clifford, [1891] 8 T.L.R.103.
[2] Morgan *v.* Hardy (1888); Hardy *v.* Fothergill, 13 App. Cas. 351 H.L.
[3] Proudfoot *v.* Hart (1890), 25 Q.B.D. 42.

THE HOTEL

PART I.—ENTRANCES, LIFTS, STAIRCASES, BEDROOMS AND BATHROOMS

IN most cases, modern hotels are specifically planned and equipped to cater for different sections of the public. In general, however, the broad divisions or types of hotel may be cited as :—

(1) The large-city hotel.
(2) The small-city hotel.
(3) The seaside-resort hotel.
(4) The " spa " hotel.

These main divisions are suggested partly by the type of guest catered for, and partly by locality.

Once the hotel is planned and built, mistakes are very difficult to rectify. Care must be taken to so plan and equip the building that it will function satisfactorily for many years, without excessive annual maintenance charges. To be successful, careful co-operation between the architect and future management of the hotel is essential. Relatively few buildings are found to have such diverse plan requirements, combined with so many types of mechanical equipment. The plan, construction, and equipment must all be considered so that maximum comfort and service are afforded to the guest, while the interests of the management are looked after in that annual maintenance rates are as low as possible.

Each of the main divisions or types of hotel may of course be again sub-divided into various grades—luxury, medium, and cheap. In other words, the type remains constant, while the quality may vary.

Size of Hotel

This problem has two main aspects :—

(*a*) When the proposed scheme comprises a completely new hotel.

(*b*) When the scheme consists of enlarging or extending an existing hotel.

Obviously the latter case presents the easier problem, as in all probability definite facts, data, statistics, etc., are available as to what further business may be justifiably expected and obtained.

It is perhaps wise to plan a new hotel so that it may be extended in the future, should it be necessary. Obviously a building that is too big

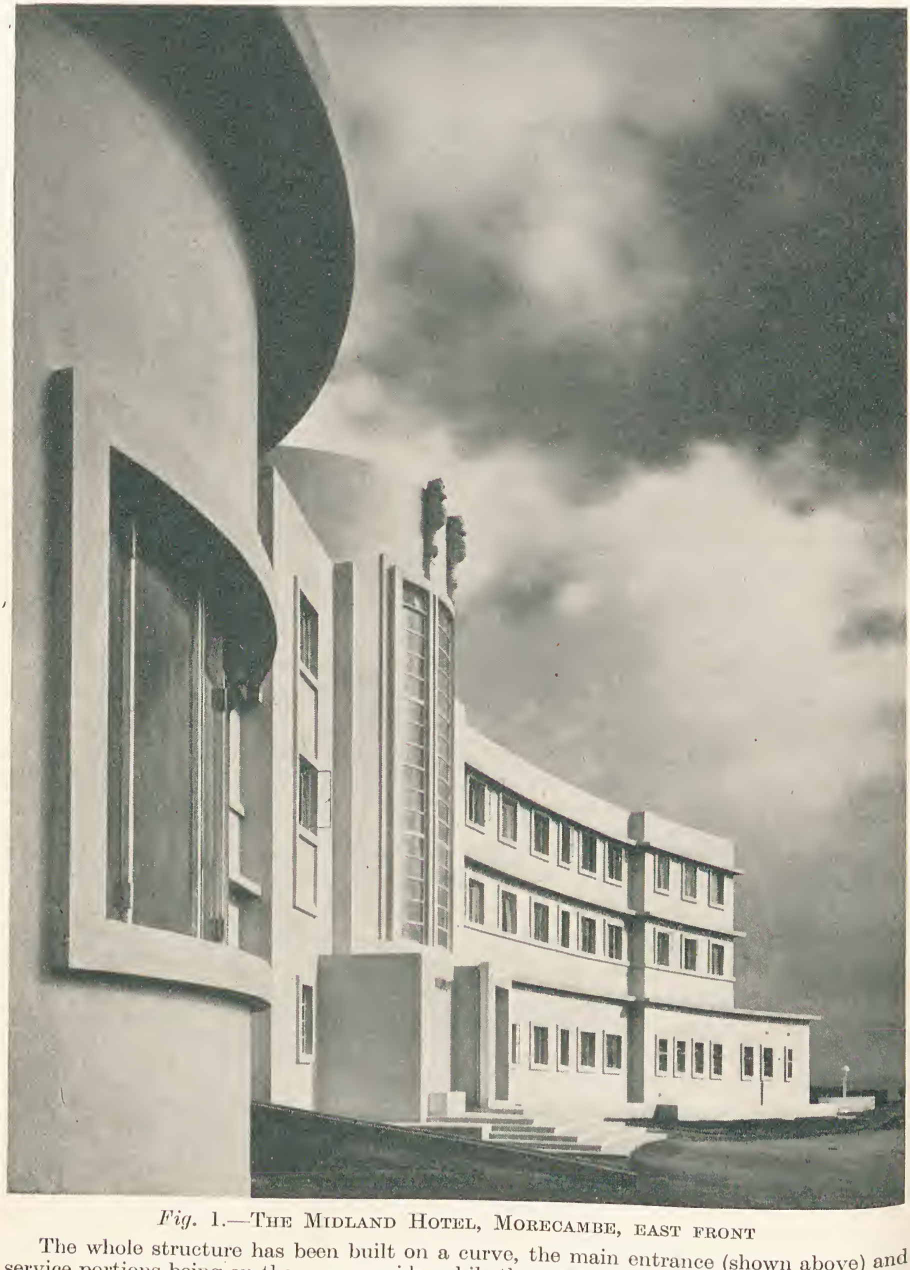


Fig. 1.—THE MIDLAND HOTEL, MORECAMBE, EAST FRONT

The whole structure has been built on a curve, the main entrance (shown above) and service portions being on the concave side, while the reception and guest rooms are on the convex side, overlooking the sea. See also page 215. (*Architect—Oliver Hill, F.R.I.B.A.*)

for the requirements of the locality, and thus partly empty, results in a serious fall in the profits. Again, the site may not lend itself to a plan which could be easily extended. Extension may take place either horizontally or vertically. Horizontal extension would be necessary for public rooms, and vertical extension for additional sleeping-quarters, though obviously an extension scheme may be a combination of the two.

Plan Organisation

The principal divisions of the hotel plan are listed below, though of course these divisions cannot be kept entirely separate in plan though they may be, more or less, as regards staff working.

(1) *Management*

Comprising : accounting, buying, advertising, correspondence, maintenance, staff, etc.

(2) *Public Rooms*

Comprising : lounges, restaurants, grill rooms, ballrooms, banquet and private dining-rooms, etc.

(3) *Service*

Comprising : kitchens, service, bars, etc., trades entrances, luggage.

(4) *Bedrooms and Bathrooms*

(5) *Allied Sub-divisions*

Comprising : tennis or squash courts, swimming-pools, Turkish or medicinal baths, stores, shops, kiosks, agencies, etc. These various services or amenities may be run by the management of the hotel direct, or may be quite separate concerns paying an annual rent to the management. These various divisions on plan are diagrammatically expressed in Fig. 2. It is easily seen that a proper co-ordination of so many different plan requirements and mechanical equipment of all kinds is no easy problem.

Sites

The architect is of course bound to consider the site in relation to any proposed scheme, though his work under this head may be limited in various ways.

(*a*) He may be approached by a promoter who has already selected the site and is aware of just what he requires. In this case the architect's work in connection with the site, prior to embarking on plans for any particular scheme, consists in establishing all the limitations or restrictions imposed, as in any building site. Town-planning restrictions, local by-laws, party walls, ancient lights, easements, building lines,

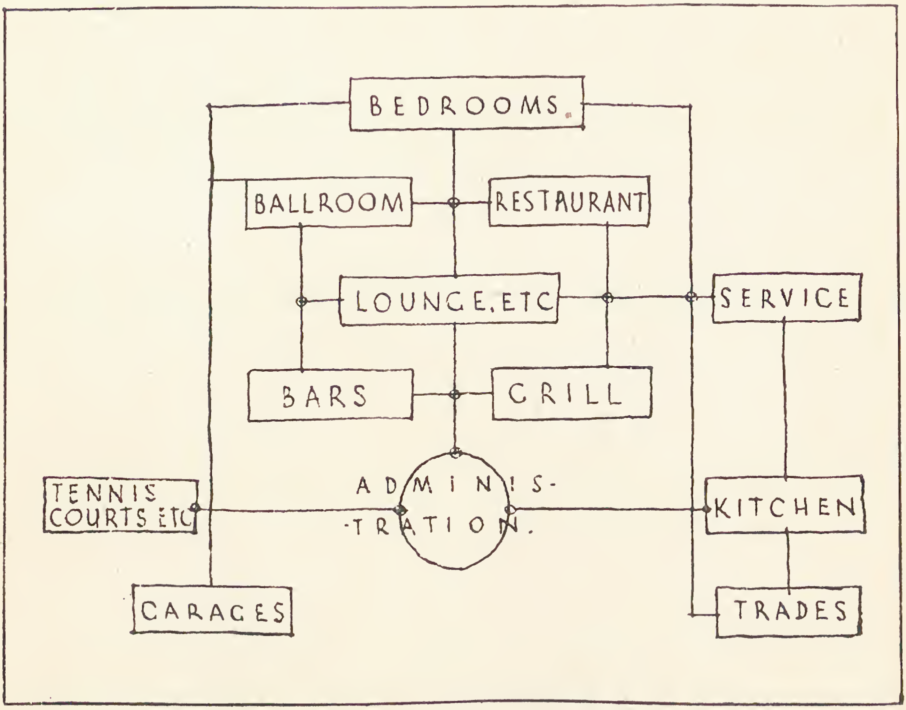


Fig. 2.—DIAGRAMMATIC KEY TO PLAN ORGANISATION

building heights, etc., must all be considered and established, as on any proposed building, before any " parti " may be conceived.

(*b*) The architect may be asked to report on a given site as to its potential suitability.

(*c*) The architect may be asked to find a suitable site.

Case (*b*) is the most common. In both (*b*) and (*c*) the architect must draft up his report based upon the following factors :—

(1) The proximity of facilities for transport, stations, etc.

(2) The proximity of existing or growing social centres, business and amusement centres.

(3) The proximity of open spaces, parks, and special local attractions likely to appeal to tourists.

(4) The proximity of garage facilities. Space cannot be spared, as a rule, to incorporate a garage in the plan.

(5) Absence of noise, both constant and intermittent.

(6) Means of access for service deliveries. These entrances must not interfere with the main entrances or general traffic.

(7) Possibility of additional revenue from shops or a store placed on the ground floors.

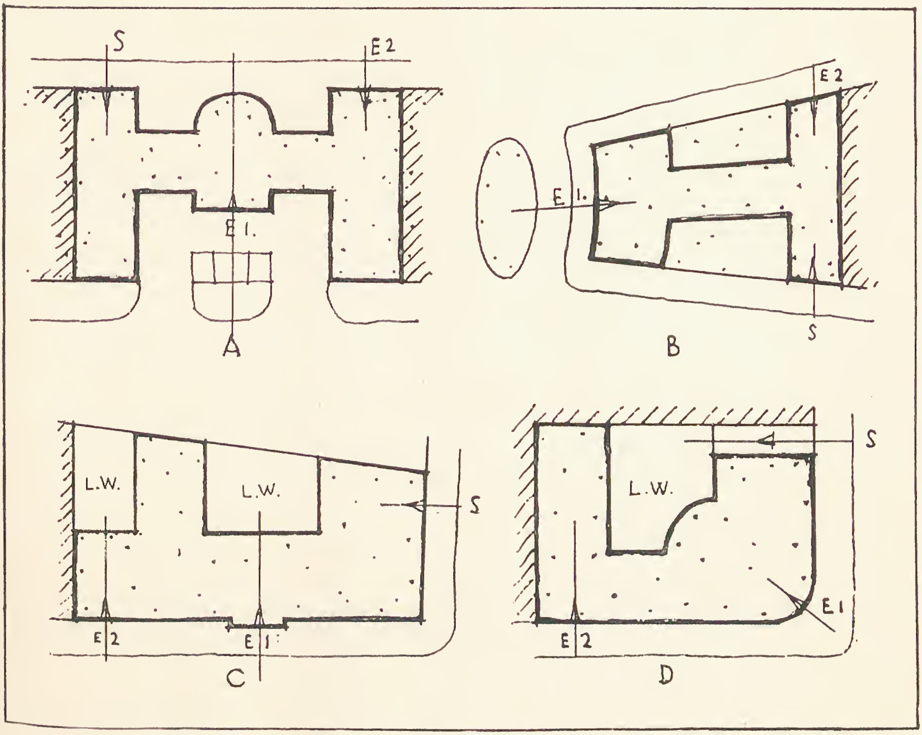


Fig. 2A.—Diagrammatic illustrations of various types of block plan

Showing main (E 1), subsidiary (E 2), and service (S), entrances.

(8) Absence of industrial buildings and noxious trades in the vicinity.
(9) Size, shape, slope, and orientation of the site.
(10) Surrounding traffic.
(11) Surrounding property should show improving ground values.

Each of these factors must be reported upon, and a decision arrived at.

Block Plans

Assuming the site has been selected; the first aspects to consider are :—

(*a*) The correct disposition of main and service entrances in relation to plan requirements and surrounding traffic.

(*b*) Provision of light and air to bedroom floors over.

Fig. 2A illustrates several typical types of layout. At A, site bounded by two roads and two party walls. Main entrance placed in best street, with service and subsidiary entrance at rear. Set-back allows cars to drive up without interfering with the main traffic stream in the street. Adequate light available for bedroom floors. Stores, internal bathrooms, etc., placed along the party walls.

B, a corner site. Main entrance on apex of site, subsidiary and service entrances at rear. Traffic congestion may occur at the service entrance in this arrangement unless deliveries are taken down a ramp direct to the floor where they are required. Good light and prospect to the bedroom plan.

C, angle site, with light wells at the rear. Main and secondary entrances on same side, service at the rear. Suitable if main street is a wide one. Bedroom plan not so satisfactory.

D, a rather small angle site. Difficult to plan to give adequate light and ventilation to the bedroom floors and at the same time avoid wasting too much space in areas. Entrances work well.

Entrances

There are four main types of entrance :—

(1) *The Main Entrance*

This must be placed in the main thoroughfare.

(2) *Subsidiary Entrances*

These should always lead to the main entrance hall or foyer, unless serving specific suites of rooms such as a ballroom, banqueting room, restaurant, grill, etc. They must avoid causing congestion at the main entrance. Their number must be kept down to a minimum to reduce annual maintenance charges.

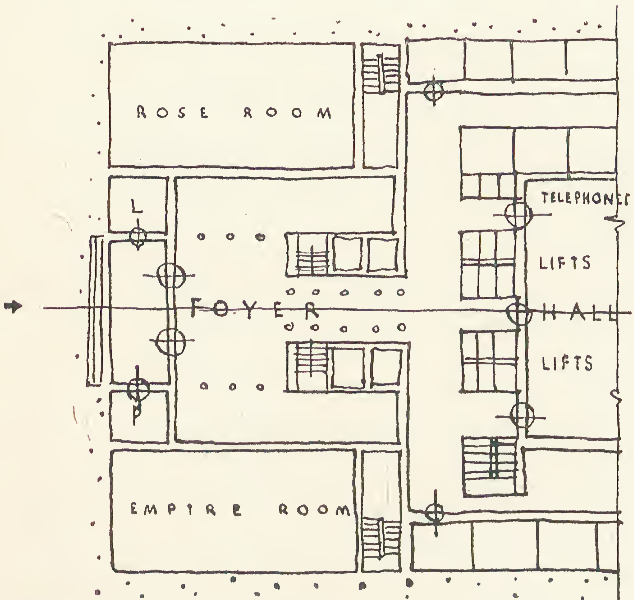


Fig. 3.—ILLUSTRATING AMERICAN TYPE OF ENTRANCE, WITH LARGE FOYER EXTENDING OVER GREATER PART OF GROUND FLOOR

(3) *Luggage Entrance*

This should be on street level adjacent to but separate from the main or subsidiary entrances. This facilitates handling of luggage and saves time. No luggage should be taken through the entrance hall in any hotel except perhaps in the really cheap-grade class; it should be taken direct to a luggage lobby on each bedroom floor.

(4) *Service Entrances*

These should be placed as far away

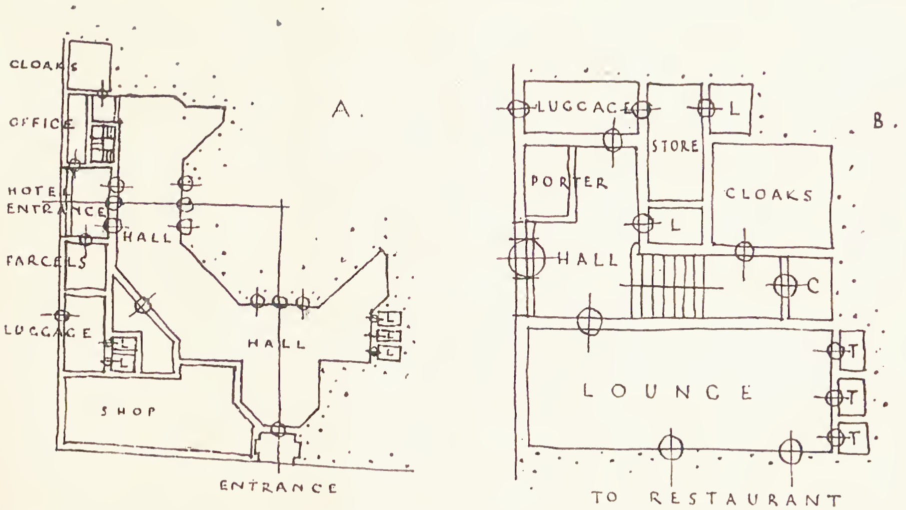


Fig. 4.—A, ARRANGEMENT OF MAIN ENTRANCE. B, ARRANGEMENT OF SUBSIDIARY ENTRANCE

from the main entrance as possible, yet adjacent to the departments they serve. They must not cause traffic congestion. These entrances are apt to be noisy, and care must be taken to avoid annoyance to guests.

Entrance Halls

The main entrance hall usually takes the form of a lounge in which are arranged the various offices or counters dealing with mail, cash, inquiries, keys, registration, etc.

The main staircase and passenger lifts discharge here, and entrances to the main public rooms lead off it.

Efficiency in planning to avoid congestion is obviously of paramount importance. All the units previously mentioned must be easily seen on entering the hall, but must be so placed as not to interfere with the main circulation.

This entrance hall may in itself be relatively small, leading to a more spacious lounge; or may be actually part of a large lounge, being separated therefrom by a light screen. This latter arrangement is particularly common in the American type of plan, in which the entrance hall often covers the whole of the ground floor (Fig. 3).

Cloakrooms

Cloakrooms should be placed near the entrance hall. Fig. 4, A, illustrates an entrance hall placed round a central, octagonal lounge. The main and secondary entrances are on adjacent streets, with proper arrangements

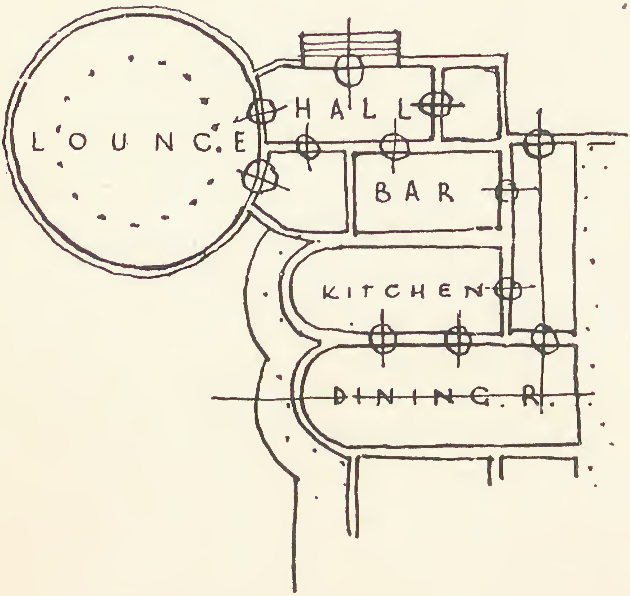


Fig. 5.—ARRANGEMENT OF MAIN ROOMS ROUND ENTRANCE HALL IN A CONTINENTAL PLAN

for lifts, luggage, parcel room, etc. At B is a subsidiary entrance to a grill room, showing the arrangement of cloaks, stairs, a lounge for meeting, telephones, etc.

Fig. 3 illustrates an American type of entrance hall. The lift-hall and battery are adjacent to but separated from the foyer proper.

Fig. 5 illustrates a rather curious grouping of public rooms round the main entrance in a Continental plan.

Vertical Circulation—Lifts

Lifts are primarily means of vertical circulation.

In general, never install fewer than two lifts, and a minimum ratio of one lift per 100 bedrooms. They are preferably small and of fairly high speeds, and must be easily seen by the guest and controlled by the porter.

Passenger lifts must not be used for conveying baggage or as service lifts.

Service lifts vary according to their carrying function. It must be remembered that in addition to carrying heavy weights, service lifts may have to carry extremely bulky articles, such as mattresses, wardrobes, and the like.

Lift shafts should if possible not be placed adjacent to bedroom walls, as the noise from the running of the lift may annoy guests.

Food-service lifts are mentioned later.

Passenger lifts are preferably grouped with the main staircase, and particularly on the upper or bedroom floors. This is illustrated in Fig. 6.

It is best to avoid placing lifts in the well of an open staircase ; they are much better placed in a separate, closed shaft. This simplifies the design and also minimises noise and draughts—two important items.

Staircases

These may be divided into (*a*) main staircases, (*b*) service staircases. The main staircase must serve all floors used by the guest.

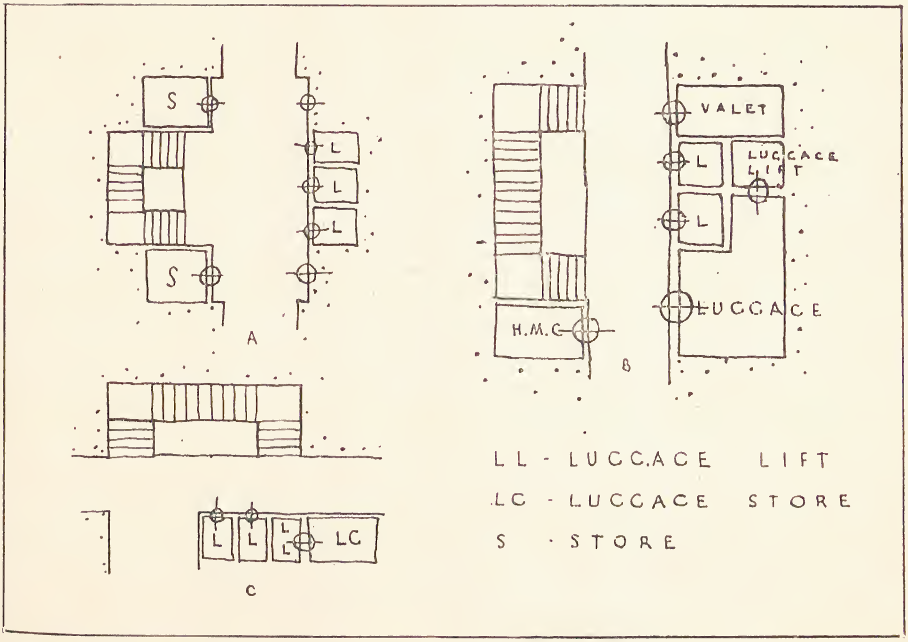


Fig. 6.—DIAGRAMMATIC ARRANGEMENT OF STAIRS, LIFTS, ETC., ON UPPER FLOORS

Its position is preferably constant on upper floors, though it need not occupy a salient position on the ground floor unless it leads to important public rooms on upper or mezzanine floors. In this case the staircase must in particular be well designed from an architectural point of view. Staircases should preferably be carpeted, both to improve their appearance and to provide reasonable quietness. They should be at least 5 ft. wide, and contain no winders.

Service staircases are usually provided for the use of the hotel staff, who are forbidden to use passenger lifts, main staircases, etc., except waiters, stewards, etc., having direct business with the guest.

These staircases provide a secondary means of escape for guests in case of fire, and therefore must be so placed and constructed as to be in accordance with local fire regulations. With this in mind, the points of discharge of these staircases must be especially considered.

It is necessary to provide each bedroom with alternative means of escape, and it is generally not allowed to place any bedroom more than 80 ft. from a staircase. This obviously affects the bedroom-floor plan considerably. In schemes based upon a cross or with radiating arms or wings, as illustrated in Fig. 8, the lengths of the corridors are controlled by this factor. In this case the main staircase is in a central position and the escape or service stairs at the ends of the wings. Fig. 7 shows another arrangement of staircases.

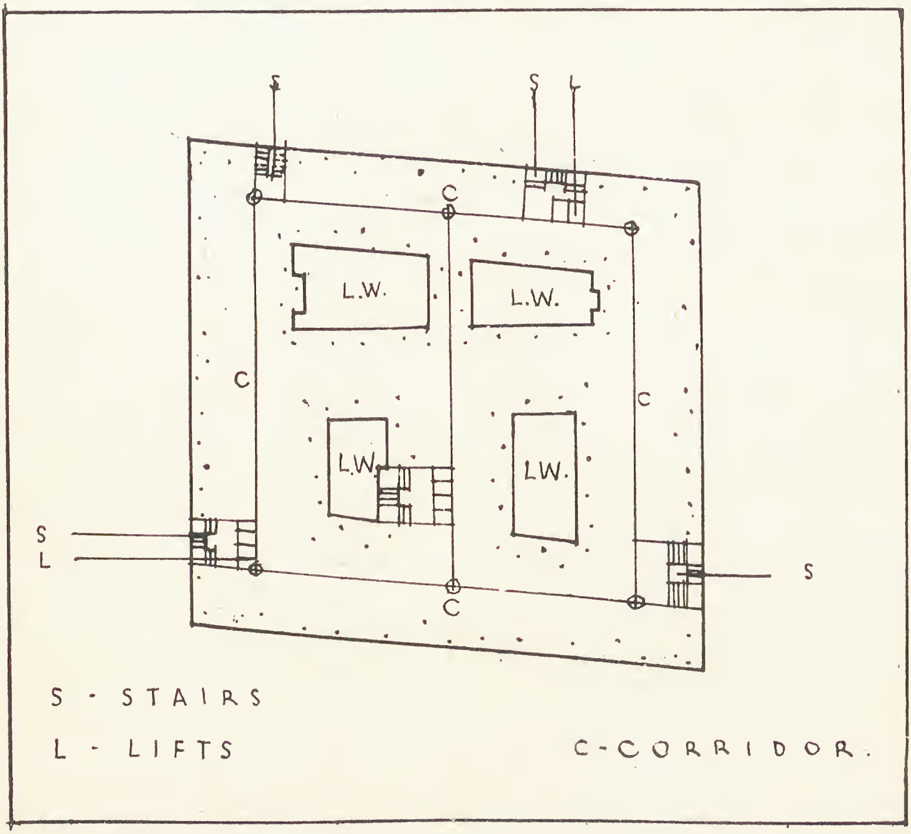


Fig. 7.—Illustrating disposition of staircases on plan

The width of service staircases must be such as to comply with the local fire regulations. Appearance and finish are secondary considerations, and materials used must be capable of resisting heavy wear and tear.

Other forms of vertical circulation or communication which also have to be considered are soiled-linen chute, letter chutes, rubbish chutes, etc. These primarily save labour for the staff, and indirectly relieve congestion and pressure on lifts and staircases.

THE BEDROOM FLOOR

After settling the main lines of circulation, the typical bedroom-floor plan is that which should receive attention. This plan is particularly important, as much of the success of the scheme is dependent upon it. The problem is invariably that of planning as many rooms as possible on each floor, and at the same time allowing adequate light, air, and prospect to each room. Internal areas must be avoided wherever possible. It is

usually possible to vary and adjust the ground-floor plan to accommodate the upper floors. This must be done without question if necessary.

Seven or eight floors of bedrooms must not suffer by the urge to retain some particular feature on the ground floor.

The general floor plan is composed of the bedroom units, which must be most carefully considered in relation to plan, comfort, ease of running, structure, etc. A suitable bedroom unit is generally evolved, and the remaining rooms, such as bathrooms, w.c.s, service rooms, maids', valets', waiting-rooms, etc., planned within one or two of the standard bedroom units. Wherever possible, bedrooms must have prospect—particularly in the case of seaside hotels. Where suites of rooms are required they are usually most easily planned in wings where they do not upset the steel grid which is designed to the standard bedroom unit.

Bathroom Planning

The old idea of placing a few bathrooms at the end of a corridor for the joint use of guests has now been completely superseded. Bathrooms are now placed between two bedrooms, or in some cases form part of the bedroom unit itself. This means a bathroom to each bedroom. There is no doubt that this arrangement is the best, though it is only recently that building regulations have accepted the internal bathroom with waste pipes taken into a duct. There is, of course, nothing new in the idea, though its practical expression has long been overdue in this country. It is almost impossible to dissociate bathroom and bedroom if an internal, artificially ventilated bathroom is to be provided.

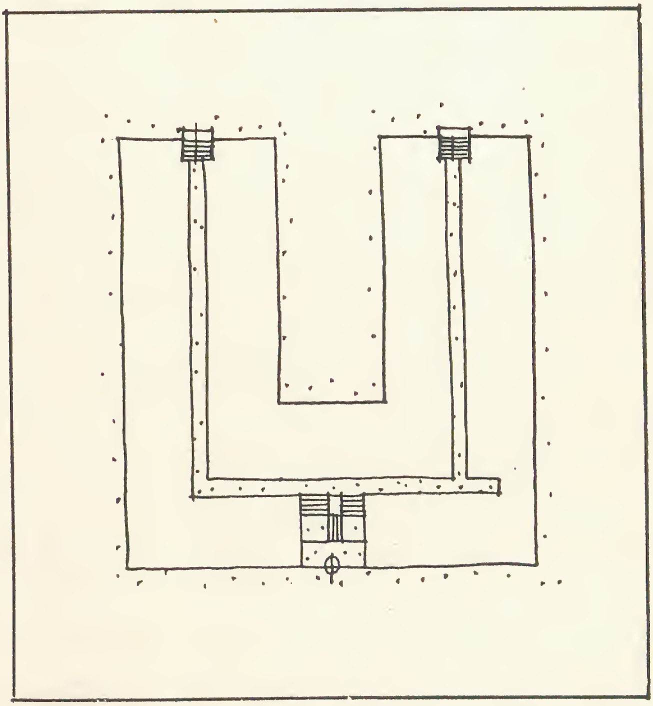


Fig. 8.—Illustrating disposition of staircases on plan

The advantages

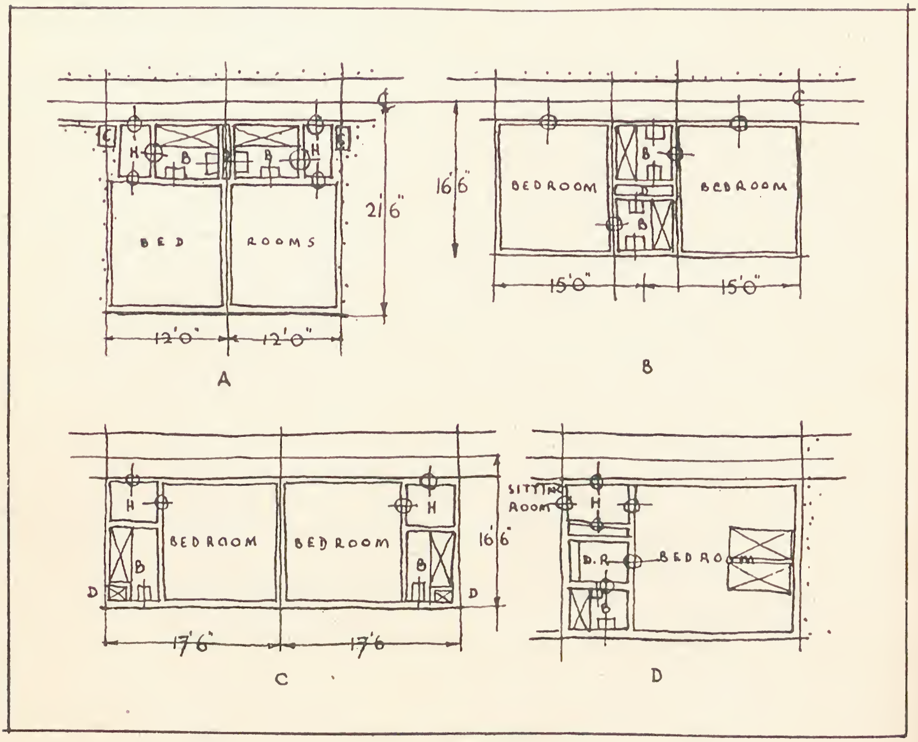


Fig. 9.—DIAGRAMMATIC ILLUSTRATION OF SEVERAL ARRANGEMENTS OF THE BEDROOM UNIT

A.—This arrangement allows of the maximum number of units in a given frontage. B.—Bathrooms placed between the bedrooms. C.—This arrangement is wasteful as regards frontage, but economical as regards depth. D.—Unit suitable for better-grade type of hotel.

derived from the properly planned internal bathroom are numerous, and may be cited as :—

(1) Facilitates planning a bathroom to each bedroom.

(2) Avoids wasting valuable frontage, hitherto devoted to bathrooms to get waste pipes away.

(3) Waste pipes no longer adorn the whole of the main elevations.

(4) Pipes no longer tend to freeze up in winter, causing much annoyance, and being a potential source of trouble.

(5) Artificial ventilation extracts foul air from the bathroom and prevents it getting through into the bedroom. The open window tends to blow back such air into the bedroom.

(6) A bathroom to each bedroom eliminates much staff work—carrying water, emptying slops, etc.

(7) More bedrooms may be planned in a given length of frontage.

(8) More convenience and privacy given to the guest.

There seems little doubt that, in future, hotels must provide a bathroom to each bedroom.

Two Single Beds Are now Popular

Again, it may be noted that the double bed is becoming increasingly unpopular, two single beds being preferred. This affects the planning of the bedroom unit. The extra space required is very little, and in the case of seaside hotels, etc., two friends will often share a room with single beds although they would not share a double bed. Bedrooms are tending to become smaller. This is due partly to the introduction of built-in furniture, clothes cupboards, etc., and partly to modern furniture being reduced in size.

Minimum Size of Bedrooms

The minimum size for a single bedroom should be 12 ft. by 8 ft. 6 in., and then only in a cheap-grade hotel ; 15 ft. by 11 ft. or 18 ft. by 15 ft. are average sizes for two-bed rooms in a medium-grade hotel. Naturally, opinions vary within wide extremes as to desirable sizes and shapes of bedrooms. However, it all depends on deciding upon a steel grid or unit which may be kept constant throughout the scheme, so that bedrooms, either singly or in groups, may be fitted to the grid. For example, a unit may be selected which will allow of three single rooms occupying the same space and area as two double rooms.

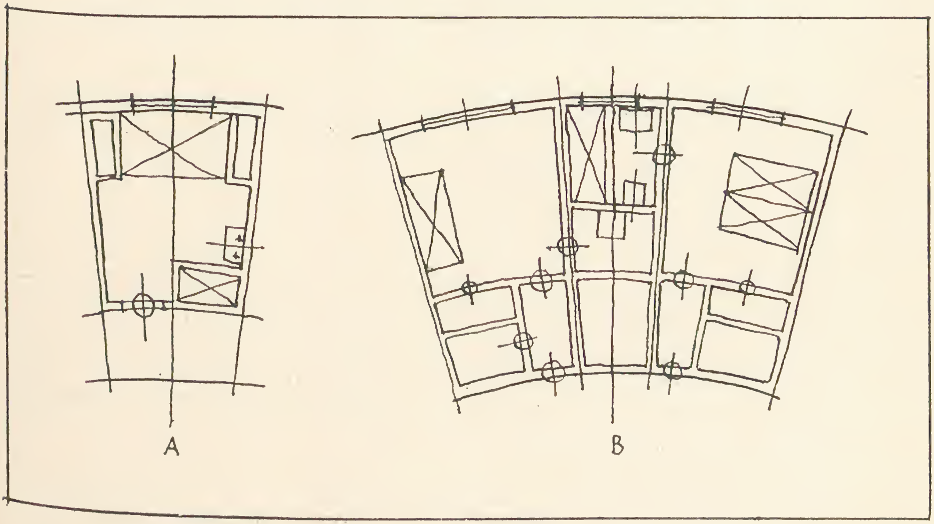


Fig. 10.—Continental bedroom schemes: A, single unit. B, double unit

Some Types of Bedroom Unit

Fig. 9 illustrates several types of bedroom unit.

A requires a frontage of 12 ft. per bedroom, and a depth from the centre of the corridor of 21 ft. or 22 ft. This arrangement allows of the maximum number of units in a given frontage. The bathrooms are placed on each side of a central duct which houses all the wastes. An entrance lobby off the main corridor is provided, with a cupboard to each lobby. Artificial ventilation and light are of course required for the internal bathrooms. The plan allows of about eight units per 100 ft. of frontage.

B illustrates an arrangement in which the bathrooms are placed between the bedrooms. One bathroom in this case is external, one internal, though the waste pipes are still taken down in an enclosed duct. The bedrooms are entered directly off the main corridor, thus a certain amount of privacy is lost. Similarly, the bathrooms are entered from the bedrooms, which results in a loss of wall space. The depth of the unit is, however, materially decreased.

C—in this case the bathrooms are external, though again waste pipes are taken in a duct. Ducts which are placed on external walls are more easily handled below the level of the lowest bedroom floor than those placed internally and which may obviously occur at extremely inconvenient positions in the main rooms on the ground floor. A small lobby again acts as a buffer between the corridor and the bedroom. This arrangement is relatively wasteful as regards frontage, though again economic as regards depth of unit.

D illustrates a unit suitable for a better-grade type of hotel. This unit shows an external bathroom, entered off a small dressing-room. A hall or lobby, with adequate cupboards, is provided, and a sitting-room may be entered off the lobby, thus providing a compact self-contained suite.

Fig. 10 illustrates a double and single unit from a Continental example. In this case the main corridor takes the form of a gentle ramp, thus dispensing with staircases altogether.

Bedroom Equipment

Bedroom equipment varies according to the type and grade of hotel. Central heating is essential. Sometimes it is omitted in seaside hotels having a very short season, though obviously its introduction assists in keeping the hotel in good condition when closed. Radiators must be controlled by the guests, and the system should permit rapid increases in temperature to warm the rooms quickly. The following equipment should be carefully considered :—

(1) Gas or electric fires are desirable in addition to central heating. These may be run off coin-slot meters. Coal fires are troublesome, creating difficulties such as provision for fuel storage, removal of ash,

etc. In bedrooms they are hardly required, except perhaps in luxury-grade hotels. Flues take up much valuable floor space on upper floors.

(2) Wardrobe cupboard is now becoming essential, and is usually a built-in fixture.

(3) Dressing-table, bedhead fixtures for books, etc., writing-table, easy chair or chairs, curtain boxes, etc., are all essential.

(4) Adequate lighting points, both general and local, over bed and dressing-table, are necessary.

(5) A close-fitting carpet is pleasing and dispenses with much labour. Cheap-grade hotels still seem to favour polished floors and rugs, though it would not appear to be much cheaper, as in this case the flooring material has to be of reasonably good finish.

(6) Baths should not be too small. A 5-ft. 6-in. bath is the minimum. Showers in this country are not as popular as elsewhere.

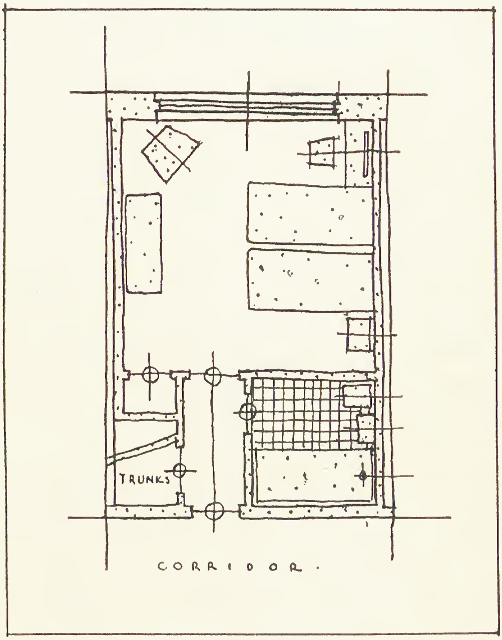


Fig. 11.—Typical bedroom equipment

Proportion of Double Rooms to Single Rooms

The proportion of double rooms to single rooms varies considerably, according to the type of hotel and guest anticipated, and can be computed with any degree of accuracy only by the management. Single rooms are in great demand in commercial hotels and in "spa" hotels, where there may be a large number of invalids. In seaside hotels the ratio seems to be about 40 per cent. single to 60 per cent. double.

It does seem logical, however, that in general as many of the rooms as possible should be planned so as to accommodate two persons. This means that greater flexibility is afforded the management, and allows of rush periods being adequately handled.

Service Rooms on Bedroom Floors

These should comprise linen store, maids' store, furniture store, food-service room.

Linen Store

This is supplied each day from main linen store, and may be artificially lighted. It must be heated and ventilated, and should have open slatted shelves not less than 24 in. deep. A bedroom-floor linen room facilitates the daily collecting of soiled linen, which is placed in a chute and taken to a sorting and packing room in the basement.

Food Service

Provision may vary from that affording facilities for making morning tea to that for providing a full-course dinner.

It is preferable to connect this room direct to the kitchen by means of one or two food lifts. Food-service rooms must be fitted with a sink, draining-boards, facilities for making tea, toast, coffee, sandwiches, etc. Provision for the storage of china, glass, etc., used on the bedroom floors minimises breakages.

Corridors

Main corridors on bedroom floors should be a minimum width of 7 ft.

They should be carpeted (except, perhaps, borders), and borders may cover ducts for service pipes, etc., which are thus easily reached by means of inspection covers.

Fanlights over Bedroom Doors

Fanlights placed over bedroom doors to light or ventilate corridors are disliked by guests, as they allow noise to enter the bedroom.

Corridors are frequently not taken the full height of the adjacent rooms, but are provided with false ceilings forming ducts to conceal service pipes.

QUESTIONS AND ANSWERS

What are the four main types of Hotel Entrance ?

(1) Main, (2) subsidiary, (3) luggage, and (4) service entrances.

Where should Service Entrances be placed ?

As far away from the main entrance as possible, yet adjacent to the departments they serve. Traffic congestion should be avoided.

How many Lifts should there be ?

Generally, not less than two, and a minimum ratio of one lift per 100 bedrooms.

THE HOTEL

PART II.—PUBLIC ROOMS

PUBLIC rooms, such as lounge, grill, restaurant, writing-room, ball-room, etc., may now be considered both individually and grouped together.

Figs. 1 to 5 illustrate several arrangements in plan of principal public rooms. The main factors to be considered in dealing with each room are given below.

Lounge

This may take the form of a corridor room leading to other public rooms, or may be a completely separate room.

The former type is best suited to the type of hotel in which guests do not stay for any length of time. It is difficult to design and furnish, and must not be so long and narrow as to appear like a wide corridor.

The latter type is most suitable in general, and particularly for sea-side, spa, and residential hotels.

In city hotels it is usually impossible to rely on natural light and ventilation. Top light from areas may be available, but is apt to be gloomy. Seaside and spa hotels must have natural light and ventilation to the lounge.

The shape of the lounge is preferably of a positive nature ; i.e. square, circular, octagonal, etc.

Care should be taken to provide a certain sense of privacy for small groups of people. This may be achieved by alcoves, differences in floor levels, considered seating arrangements. This is particularly necessary in commercial hotels, where much business may be discussed.

Bar service should be adjacent to the lounge in most cases, if not actually part of it, and the lounge may be approached down a few steps. This change of level enhances the appearance, and enables guests to find friends easily.

Furnishings should be comfortable. Small tables are preferred to large ones.

It is obviously impossible to lay down definite rules as to the sizes of lounges. They should, however, be as large as possible without encroaching on other public rooms which are revenue producing.

When the lounge is planned as a separate room, it should be so placed as to be easily approached from the entrance hall, yet off the main circulation.

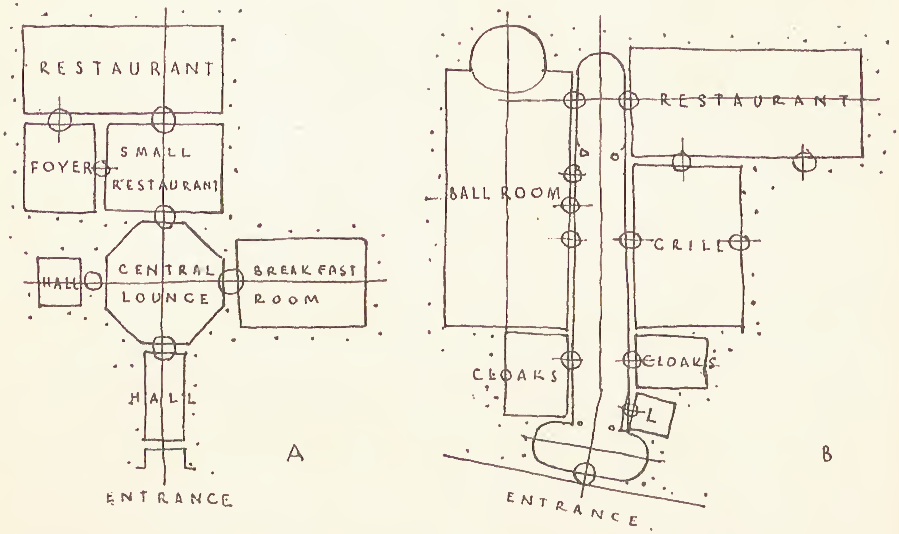


Fig. 1.—Examples of the grouping together of the main public rooms

A. Central lounge approached by main and secondary entrances and providing access to restaurant and breakfast room.

B. Lounge is long and narrow and serves principally as a means of approach to ball-room, grill, and restaurant.

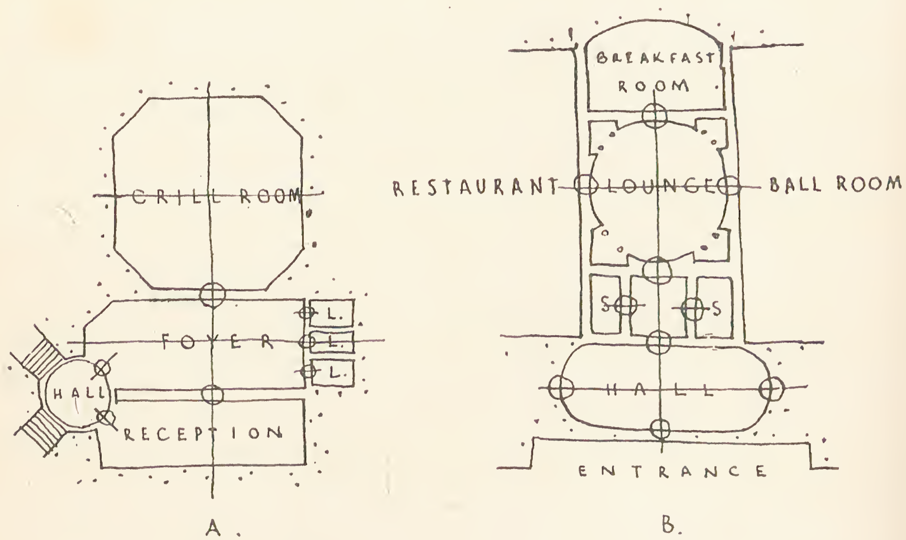


Fig. 2.—Two more examples of grouping of main public rooms

A. Main lounge divided into reception portion and a foyer leading to the grill room.

B. Lounge axially placed, providing access to the other public rooms.

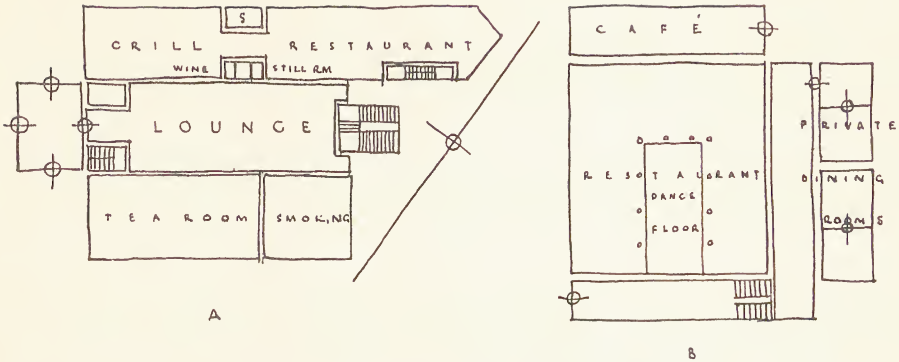


Fig. 3.—Grouping of public rooms

A. A central lounge giving access to other public rooms. Auxiliary approach is provided to the restaurant and grill.

B. Restaurant with dance floor and group of private dining-rooms.

General Arrangement of Public Rooms

Several examples illustrating the general arrangement of public rooms may be seen in Figs. 1 to 5.

At A in Fig. 1, a central lounge, approached by main and secondary entrances, and providing access to restaurant and breakfast room.

At B the lounge takes the long, narrow shape previously referred to, and functions principally as a means of approach to ballroom, grill, and restaurant.

At A in Fig. 2, the main lounge is divided into a reception portion and a foyer leading to the grill. The lift battery is placed at the end of the foyer. At B the lounge is axially placed, approached from a hall which is completely cut off. The lounge then provides access to the other public rooms.

In all the examples note the very definite plan shape of the lounge.

Fig. 3 shows at A a central lounge giving access to other public rooms. Auxiliary approach is provided to the restaurant and grill. At B is illustrated a restaurant with a dance floor, and a group of private dining-rooms planned *on suite*.

Fig. 4 illustrates an arrangement of public rooms in a luxury-type hotel. The ballroom is in this case the predominating plan unit. Here, instead of one main lounge, we find several subsidiary and smaller units, all of which function as such, and which facilitate the division of the plan into separate units for private functions. Again, note the very definite shapes of the various plan units.

The Continental example shown in Fig. 5 illustrates the grouping of restaurant, banquet, café, and private dining-rooms. The hall in this case is planned as a lounge, which avoids becoming merely an approach to other rooms.

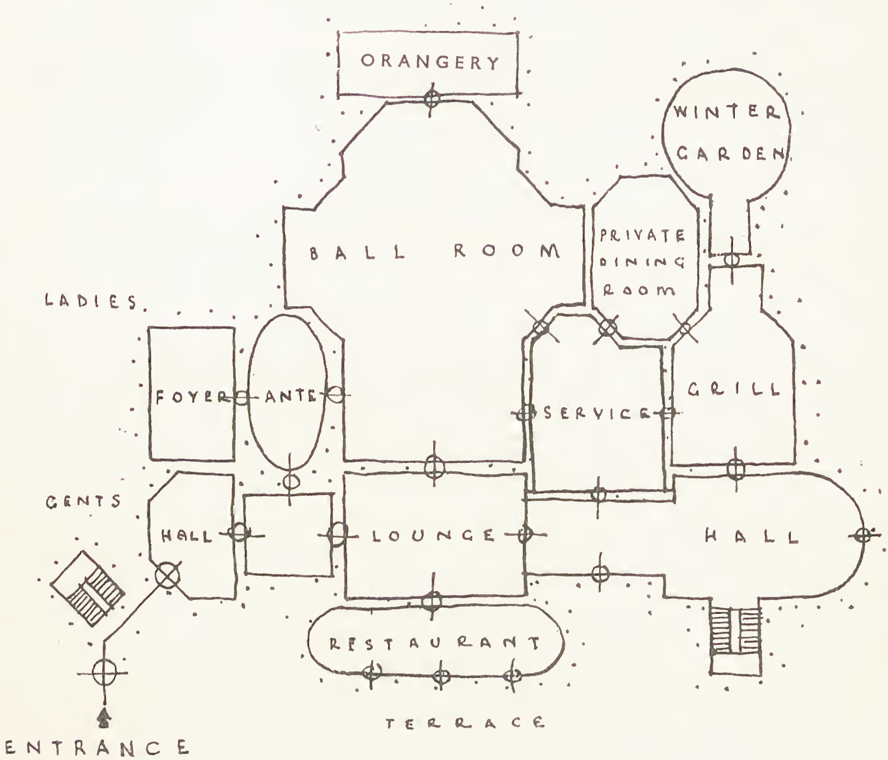


Fig. 4.—ARRANGEMENT OF PUBLIC ROOMS IN A LUXURY-TYPE HOTEL

Restaurants

Restaurants must be planned in relation to kitchens, service rooms, and main entrances. The principal factors to consider are :—

Shape

A rectangular shape is probably best, with service in centre of the long side ; least delay is caused in service, and the tables are accommodated most easily.

Service

Service doors should be placed as centrally as possible and *not* in the corners of rooms. Doors are best grouped, either close together to group or concentrate service, or placed sufficiently far apart to allow of tables being placed between the doors. In the former case the passage must necessarily be wide to take incoming and outgoing waiters ; in the latter case one door should be for entrance and one for exit.

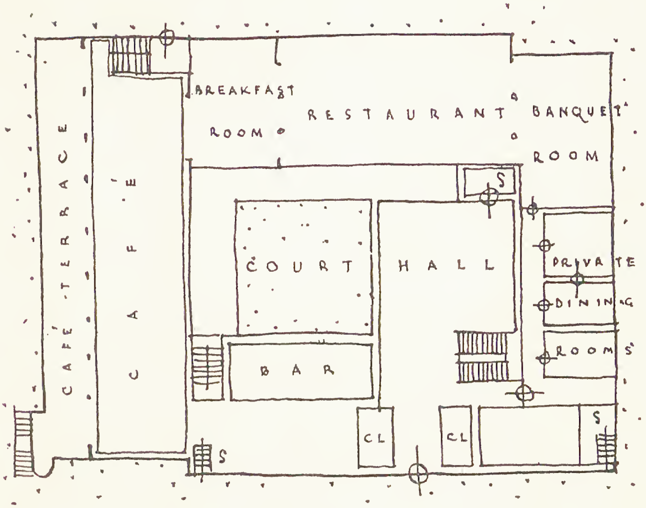


Fig. 5.—CONTINENTAL EXAMPLE OF GROUPING OF THE PUBLIC ROOMS

The hall in this case is planned as a lounge.

Open Floor

As much open, unrestricted floor space as possible is desirable.

Piers should not be placed centrally down the room. They may provide pleasant dining-alcoves if planned in relation to the table layout. Low ceilings must be avoided.

Floors should be level, to assist waiters. Where raised "terraces" are provided around a dance floor, as is sometimes the case, their widths must be determined by the table layout.

A minimum width of 17 ft. 6 in. should be taken for two rows of tables with a gangway between them, and when the tables are parallel to the terrace. Where the tables are at right angles to the terrace the width may be reduced to a minimum of 15 ft.

It is policy to place a rail round such terraces, with steps at gangways only. The minimum width for service gangways between terrace tables should be 4 ft.; there is likely to be much coming and going in this form of plan.

Floor Area per Person Inclusive of Gangways, etc.

Luxury type	15–16 ft. super per person.
Medium type	12–14 ft. ,, ,, ,,
Minimum	10 ft. ,, ,, ,,

Seating

Tables must allow a certain flexibility, to enable parties and groups of friends to be accommodated—hence square tables are preferable.

Table Sizes

Average for 2 people, 2 ft. 6 in. sq.

,, ,, 4 ,, 3 ft. 0 in. sq. or 2 ft. 6 in. by 5 ft.

Circular tables are not so popular, as they take up the same space

as the square type and cannot be placed together. Whatever arrangement is used, 18 in. is the minimum space to be allowed between chair backs where service space is not required ; 3 ft. where service is necessary ; increased to 5 ft. or 6 ft. for main gangways. Tables placed diagonally take up less space than those placed square on gangways.

Entrances

Best placed opposite side to service doors. Service doors should be so screened as to prevent guests seeing through into either kitchens or service rooms.

Dancing

Where provision for dancing is required, the following points are worthy of comment :—

(1) Where dancing is regular, a special sprung floor may be provided.

(2) Where facilities for dancing may be required only occasionally, the floor may be polished and covered with a carpet.

(3) Dance floors should be either square or rectangular, with a minimum of 22 ft. in either direction.

(4) Dance band should adjoin the dance floor, and should be on a raised platform ; minimum size, 15 ft. by 9 ft.

(5) Care must be taken to avoid service of the restaurant being adversely affected by the dance floor. This may happen by having to place the service door in an end wall, to allow facilities for dancing.

Writing-room

A writing-room is always required in any hotel. In commercial types considerable space must be allocated to it.

(1) Quietness is essential.

(2) Tables may be placed facing the walls or at right angles thereto. It is claimed that the former arrangement aids concentration. Sometimes tables are placed back to back, so that guests face one another. This is usually disliked by guests, while the screens often put up to prevent writers seeing one another are invariably unpleasant in appearance.

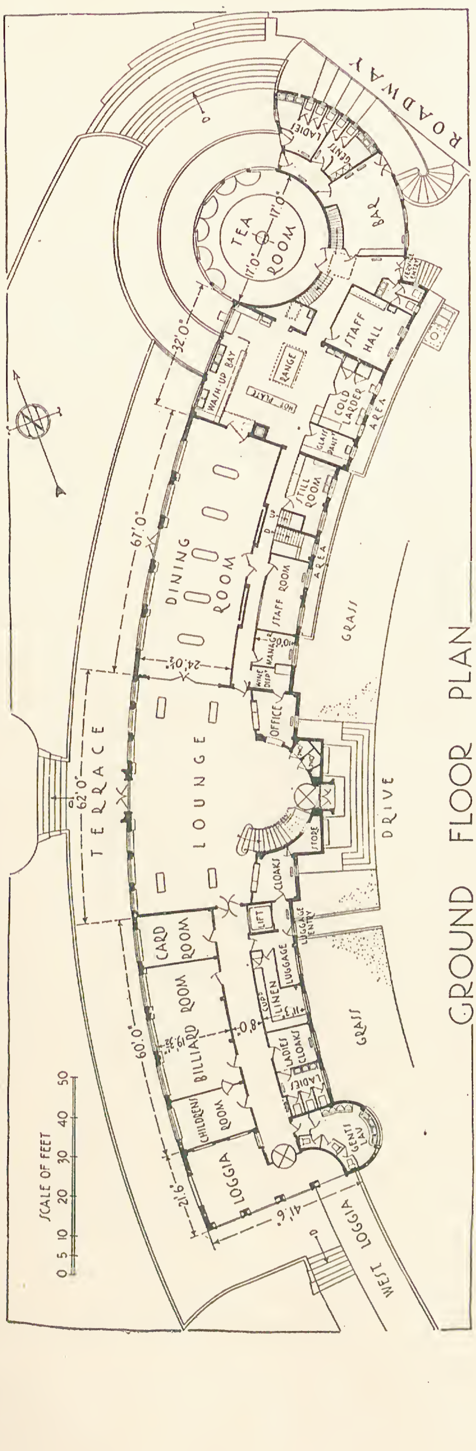
(3) Adequate light, both natural and artificial, to each table is essential.

(4) The decoration should be restrained in character, and a close-fitting carpet is desirable.

(5) The room should be placed adjacent to the main lounge.

Banquet and Ball Rooms

These are frequently desirable for temporary and private functions, and are best placed on ground-floor or street level ; if in the basement, adequate ventilation is essential. If the ballroom is to be used apart from the hotel proper, a separate entrance, cloakrooms, lavatories, etc.,



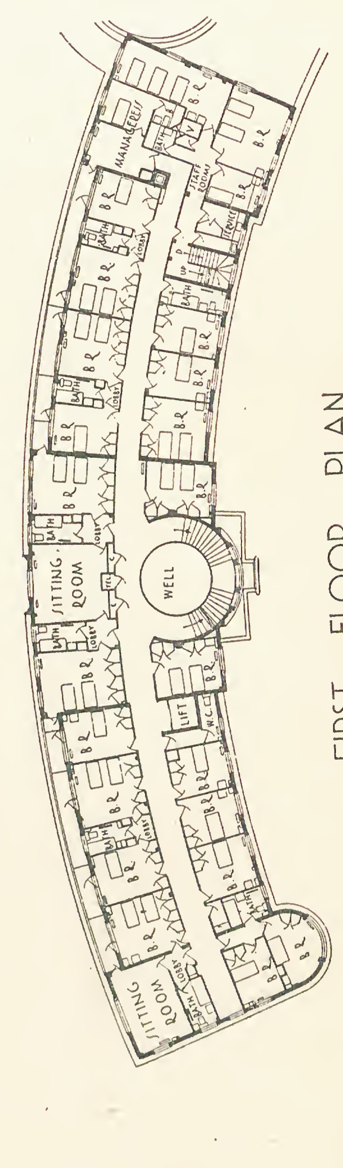


Fig. 6.—THE MIDLAND HOTEL, MORECAMBE

The general scheme of the plan is the main entrance and service portion on the concave side enclosing the forecourt, while the reception and guest rooms are on the convex side, overlooking the sea. Note the circular staircase over the entrance, rising to the roof level where a solarium is provided. Independent of the hotel is the circular café. (*Architect: Oliver Hill, F.R.I.B.A.*)

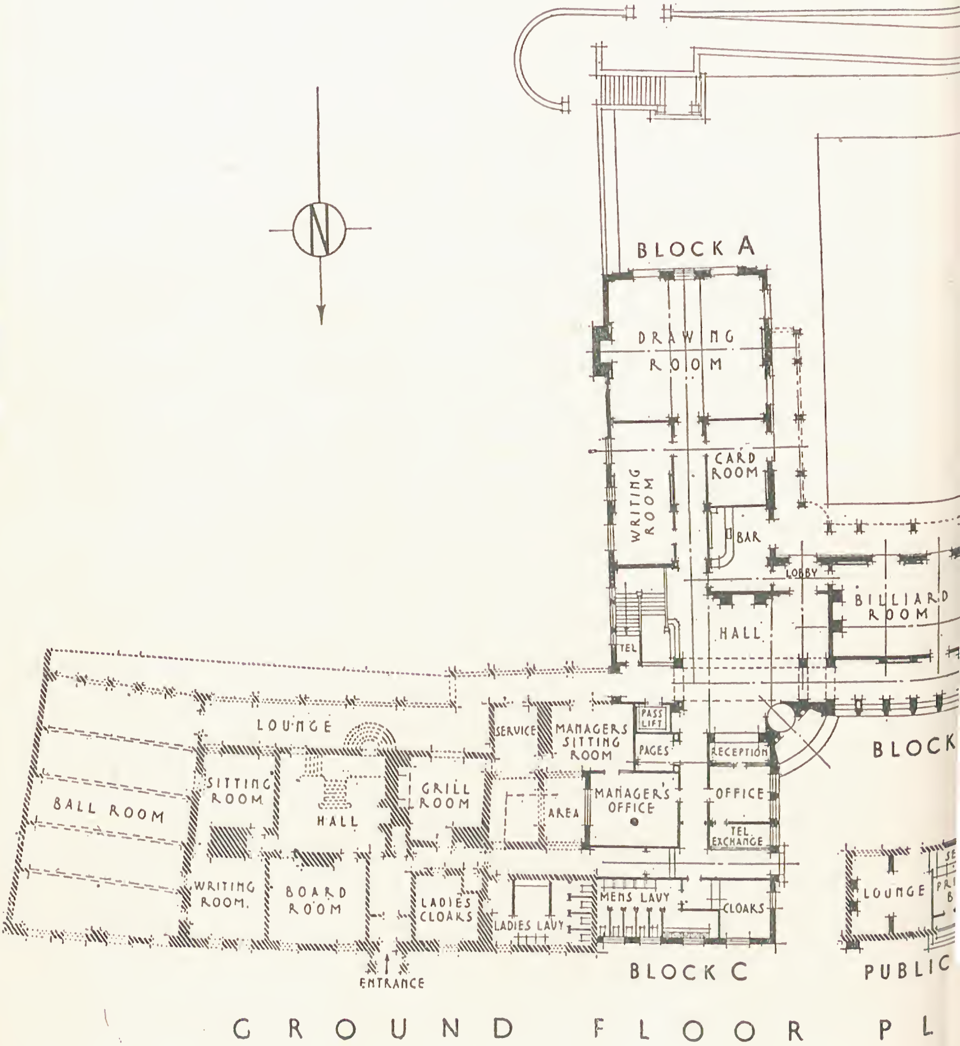
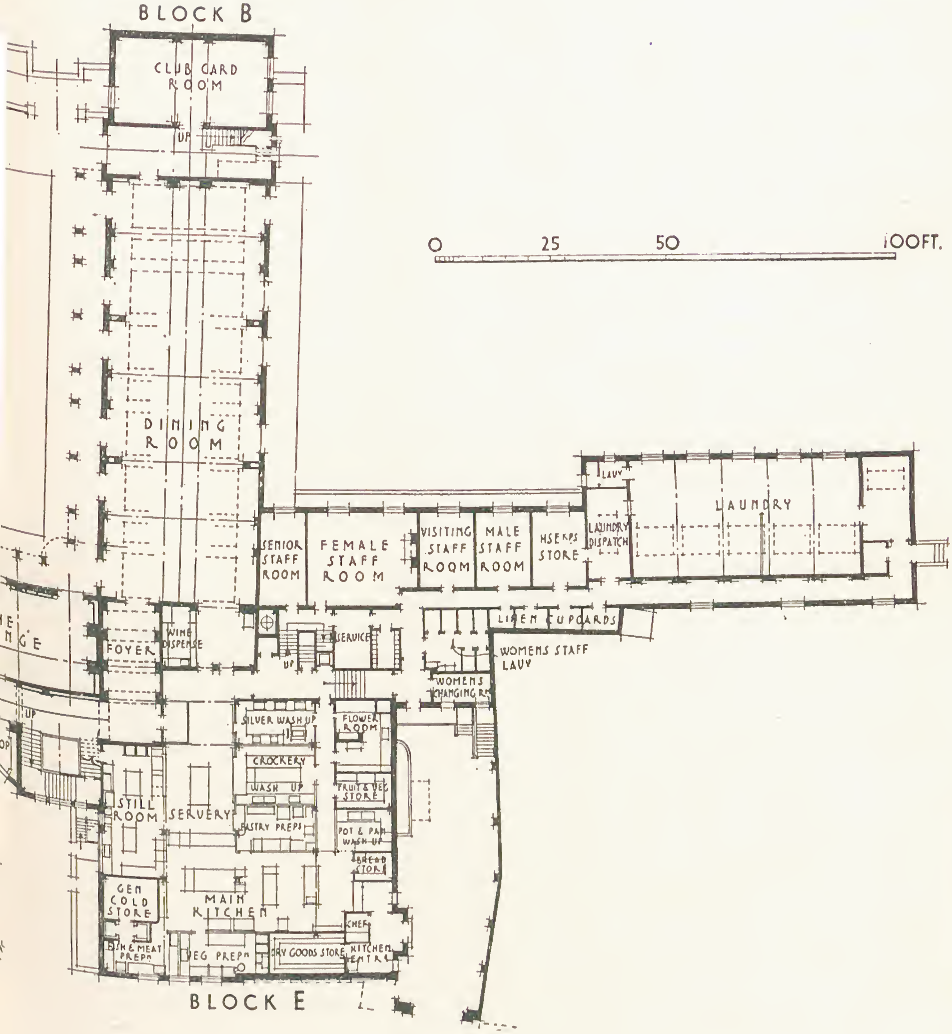


Fig. 7.—**NORBURY**
(*Architects: Stanley Hall*



HOTEL, DROITWICH

nd Robertson, FF.R.I.B.A.)

are essential. This auxiliary entrance must not interfere with the main entrance to the hotel ; a covered marquise to same is desirable.

Cloakrooms may be arranged on mezzanine level, as the main room and entrance hall thereto are usually high.

A foyer must be provided for people waiting for friends, and to avoid overcrowding at the termination of functions.

Banquet rooms are best rectangular, with high table down one long side. The average floor space per person for banquet rooms is 10 sq. ft., and for ballrooms 12–16 sq. ft. per couple.

In the case of banquet rooms the entrance is usually placed at one end, to allow for service entrances being placed on the long wall opposite the high table.

Banqueting tables are usually 2 ft. 6 in. to 3 ft. wide, and seats placed at about 2-ft. 4-in. centres. Gangways between tables should be a minimum of 3 ft. 6 in. measured between the chair backs. Main or wall gangways should be wider.

Suitable storage space is desirable in which to place tables, chairs, etc., when not in use. This must receive more consideration than may at first appear necessary. Chairs take up much room, even when stacked, and allowance must be made for rapid changes being made for different types of function.

A polished floor is usual in each case, though a properly sprung dance floor may be provided in ballrooms proper. This, of course, entails more space in the floor thickness.

In the city type of hotel, daylight is not essential ; in seaside hotels, however, use must be made of garden terraces, etc.

Private dining-rooms are generally planned *en suite* with the banquet hall. They use the same service and may be let out to individual private parties. A variety of size is desirable, from the small room some 20 ft. by 15 ft., which may be carpeted, to a larger room which may have a polished floor and be suitable for small private dances.

Kitchens

The planning and equipment of a large kitchen is a highly technical matter, and does not fall within the scope of the architect. Essential factors, however, which must be considered by the architect to enable specialised fittings and equipment to be properly installed, are :—

(1) *Size.* Kitchens are usually much too small to allow of efficient planning of equipment. The area devoted to kitchens and services varies from a minimum of 45 per cent. of that devoted to public rooms served, to 100 per cent. in high-grade types.

(2) *Position.* Possible arrangements are :—

(*a*) On same floor as rooms served.

(*b*) On same floor as principal room served, if there are many.

(*c*) On mezzanine floor, between rooms served.

(*d*) On different floor altogether, such as basement.

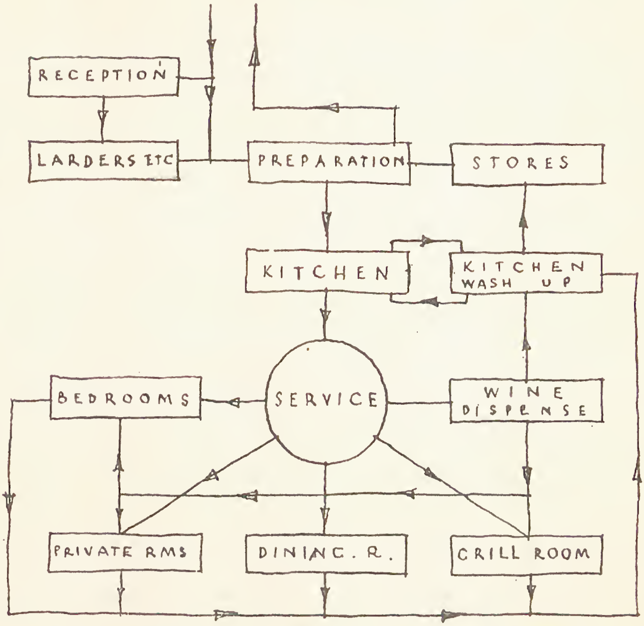


Fig. 8.—DIAGRAMMATIC EXPRESSION OF GOOD SERVICE

(*a*) Elimination of service room facilitates service and avoids congestion. Frequently space is not available for this arrangement. Suitable where number of rooms served is limited and easily arranged round the kitchen.

(*b*) involves provision of several service rooms to subsidiary rooms.

(*c*) and (*d*) involve consideration of connections by staircases or lifts. The management usually decide which form of connection they require.

(3) Wall space is very necessary.

(4) Daylight is not essential, nor is natural ventilation. Windows reduce available wall space ; roof lighting may allow smell of cooking to reach other rooms, such as bedrooms, which is undesirable. Noise may also disturb guests. Consequently many authorities consider artificial lighting and ventilation the best.

(5) Shape and size obviously vary with the site. However, an efficient equipment is facilitated by having large open spaces clear of columns, piers, walls, etc.

(6) Main kitchen and preparation rooms must be grouped together. Bulk stores, wine cellars, bakery, etc., may be separate if necessary.

(7) Minimum area required for actual kitchen and service exclusive of storage accommodation and the like is 40 per cent. of the total dining-room areas ; 50 per cent. is a more likely figure to use.

(8) If service space for waiters is provided in the actual kitchen, a minimum width of 7 ft. is required ; 10 to 12 ft. is preferable.

(9) Staircases connecting kitchen and dining-rooms should be a minimum of 3 ft. 6 in. wide ; "up" and "down" traffic should be separated ; service counters must be laid out to suit the rooms served—hot and cold plates, etc.

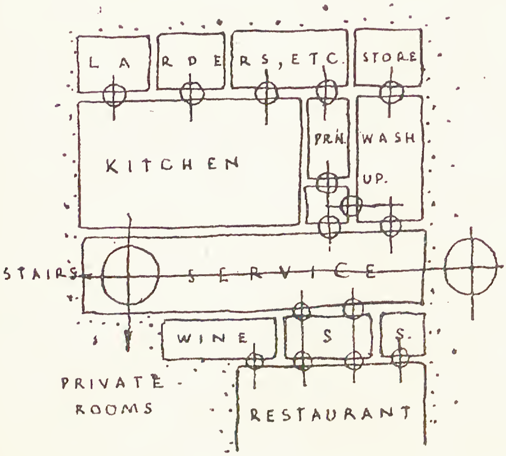


Fig. 9.—KITCHEN AND SERVICE LAYOUT

(10) Storage comprises:—

(*a*) Bulk storage of all types.

(*b*) Local storage.

Bulk storage comprises fish, meat, dairy produce, vegetables, which may require refrigeration, and dry goods, which may be stored on shelves in open storerooms. Local storage consists of bins, racks, shelves, cases, refrigerators, etc., whichever best suits the particular goods. A check office and weighing machine must be planned adjacent to the bulk storage to facilitate checking of deliveries and issuing of stores to various parts of the hotel.

Figs. 9, 10, and 11 indicate several arrangements of kitchen and service in diagrammatic form. The drawings are self-explanatory.

Service Entrance

Goods and staff may use the same service entrance, though sometimes they are separated.

Fig. 12 illustrates two typical arrangements. The plan must allow for :—

(1) A check office, to facilitate checking of the comings and goings of both staff and goods.

(2) Clerk's office, to check bulk storage and deal with parcels for guests.

(3) Goods lift large enough to handle both weighty and bulky articles.

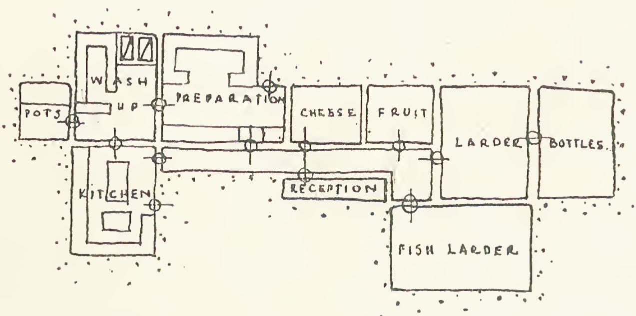


Fig. 10.—ANOTHER ARRANGEMENT OF KITCHEN AND SERVICE

(4) Weighing machine for goods, and " clocking " machines for staff.

(5) Elimination of all steps and staircases as far as possible in service departments. Use of ramps to connect changes in level.

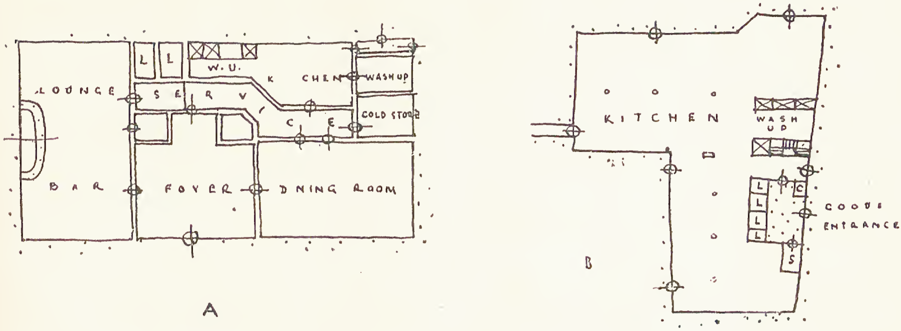


Fig. 11.—Two kitchen and service layouts

Incidental Services

Other incidental forms of service required are :—

Locker Rooms

Changing and toilet rooms for non-resident members of the staff. These rooms should be as near the departments served as possible ; they may be artificially lighted and ventilated.

Staff Mess Rooms

Separate kitchen is rarely necessary. Separate service room, china, glass, etc., desirable.

Staff Bedrooms

Sexes grouped separately in unimportant positions in the plan. Adequate toilet facilities, retiring-rooms, etc., are required. House-

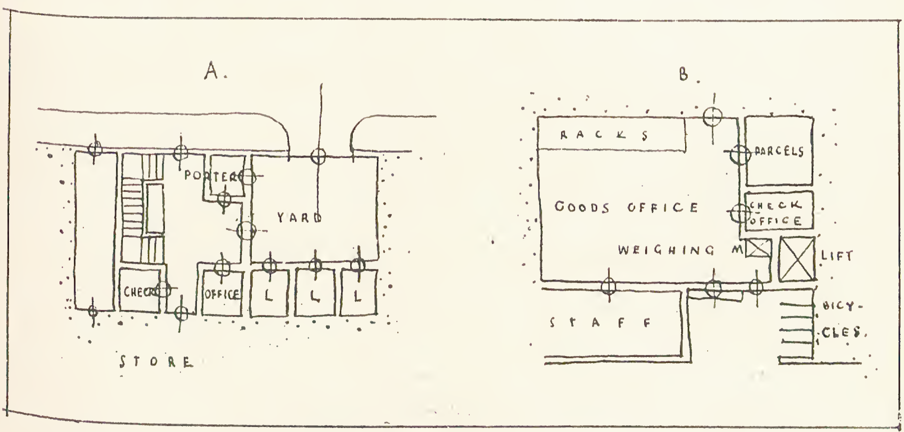


Fig. 12.—Illustrating two typical arrangements of service entrance

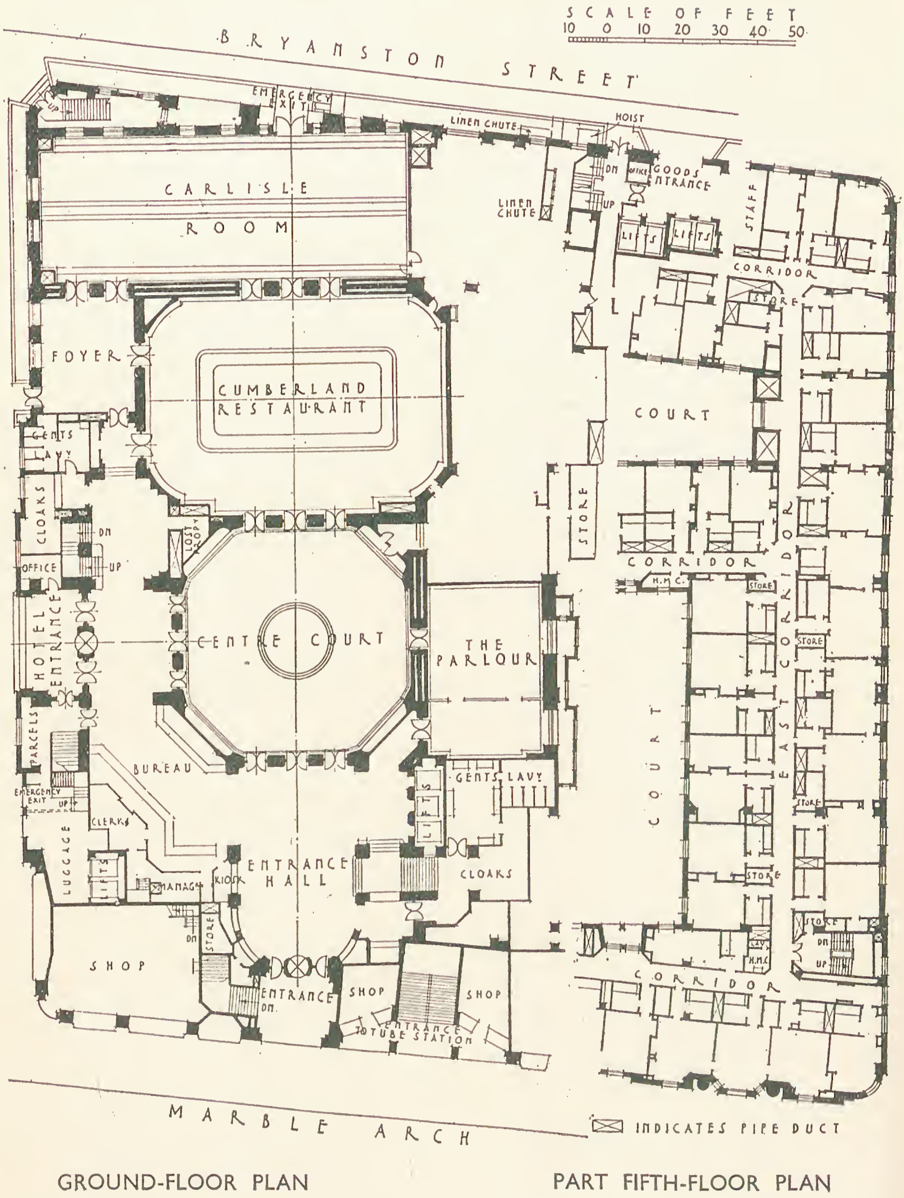


Fig. 13.—THE CUMBERLAND HOTEL
(*Architect: F. J. Wills, F.R.I.B.A.*)

keeper controlling the female staff usually has a small suite—office, bed-sitting-room, and bathroom.

Garbage

Difficult problem, owing to vast amount of different kinds of rubbish. A garbage sorting-room in the basement is desirable, where the rubbish can be sorted, packed, and disposed of.

Linen

Bulk storage room desirable, together with a sorting-room for soiled linen, connected to each bedroom floor by means of a chute. The store requires a large amount of shelving and several sorting-tables. The sorting-room is preferably near a service entrance, to facilitate removal of skips. A repair room may also be provided.

Mechanical Services

Adequate provision must be made (usually in the basement) for :—

Boiler room.

Fuel storage.

Vacuum-cleaning and refrigeration plant.

Pumps.

Lift machinery.

Workshops, etc.

These requirements are, of course, common to many buildings, and do not warrant special mention in detail.

QUESTIONS AND ANSWERS

What are the most essential considerations in the design of the Lounge ?

(1) Natural light and ventilation essential in seaside and spa hotels.
(2) Positive shape, i.e. square, circular, octagonal, etc.
(3) Methods of providing sense of privacy to small groups of people.
(4) Adjacent bar service.
(5) Comfortable furnishings.
(6) When planned as separate room, it should be placed so as to be easily approached from the entrance hall, yet off the main circulation.

How is a Sense of Privacy provided for small groups of people in a Lounge ?

This may be achieved by alcoves, differences in floor levels, and considered seating arrangements.

What is the best shape for a Hotel Restaurant ?

Rectangular, with service in the centre of the long side ; least delay is caused in service and the tables are accommodated most easily.

How much Floor Area should be provided for the Restaurant ?

A minimum of 10 ft. super per person inclusive of gangways, etc., up to 16 ft. in the luxury type of hotel.

Why are Square Tables preferable in the Restaurant ?

To allow flexibility in accommodating parties and groups of friends by placing them together.

What are the average Table Sizes ?

For two people, 2 ft. 6 in. square.
For four people, 3 ft. square, or 2 ft. 6 in. by 5 ft.

What is the best arrangement of the Tables in the Writing-Room ?

The arrangement where the tables face the walls, in order to aid concentration.

Where may the Kitchens be placed ?

(1) On the same floor as the rooms served.
(2) On the same floor as the principal room served, if there are many.
(3) On the mezzanine floor, between the rooms served.
(4) On a different floor altogether, such as basement.

How must the different Rooms of the Kitchens be grouped ?

The main kitchen and preparation rooms must be grouped together. Bulk stores, wine cellars, bakery, etc., may be separate if necessary.

What is the Area required for the actual Kitchen and Service, exclusive of storage accommodation ?

Forty per cent. of the total dining-room areas ; 50 per cent. is a more likely figure to use.

HOUSE PLANNING AND DESIGN

THE ARCHITECT'S DRAWINGS AND SPECIFICATIONS—MATERIALS

Fig. 1.—EXPLAINING THE ARCHITECT'S IDEAS TO THE CLIENT

Architect's sketch of house at Beaconsfield, Bucks, by Colin R. Crickmay, for the client's benefit.

MUCH preliminary thought is implied in the words "planning and design," so that the architect's drawings and specification, or the schedule of quantities based on them, when they appear at the builder's office for tendering, embody a train of ideas born of a client's needs, personality, and tastes. The part of the architect in scheming the arrangement and appearance of the house and its equipment varies very much according to circumstances, the most important of which is the interplay of his personality with that of his client. His imprint upon his work may thus be much in evidence or obscure, but the best results come about when he has concentrated on his client's needs and kept his own predilections well in hand. The pleasant result which may be obtained is illustrated by the view of the house at Headington. Its unobtrusive modesty of design is quite pleasing, and it is a comfortable-looking cottage where the roof space is used to its full.

Fig. 2.—MODEL OF HOUSE AT JORDANS, BUCKS

Such models aid the imagination of designer and client. (*Architects : Crickmay & Crickmay, AA.R.I.B.A.*)

In view of the individuality which an architect's work may show, it is natural if the builder regards the whole conception of the new job as being that of the architect, and if he thinks of the owner—particularly in the early days of building—rather impersonally as merely the source from which certificates are honoured. This impression may last throughout the job if the client seldom visits it. Even when he calls at the works the perfect client is chary of offering a comment which could be constructed as an instruction. He is, however, the person whom all concerned in the building are intent on satisfying.

The First Step towards the Future Building

The first step towards the future building is to make small-scale sketch-plans and elevations. If the shape of the building is complicated, and the roofing difficult to visualise, perspective or axonometric sketches, or models in cardboard, are made to explain it. Typical sketch-plans are shown in the illustration for a house to cost about £1,800, and it will be noticed that for the sake of clearness only essential details are given.

It may be explained that the word " axonometric " means a view

Fig. 3.—SMALL HOUSE IN HEADINGTON

A comfortable-looking cottage, with roof space well used. The house is built of sand-lime bricks with cream-coloured tiles. Internal accommodation consists of three living-rooms and three bedrooms, downstairs lavatory and bathroom on the first floor, kitchen, and offices. (*Architect : T. Lawrence Dale, F.R.I.B.A.*)

drawn in a conventional manner, in which, instead of using vanishing-points towards which all lines converge, the object is set up to scale on lines usually at 30° with the horizontal, the verticals being also drawn to scale. The resulting drawing conveys the appearance of a model of the building and is an aid to the imagination of both designer and client. Axonometric drawings are also of use in explaining the relation of rooms, as in the illustration of Mr. Crickmay's house at Jordans, of which the plans and view are also given.

The Sketch-plans for the Client

The sketch-plans are based on the particulars which the client will already have conveyed to the architect. Several conversations are usually needed before the designer has in his mind a picture of the house which is needed, and two or three sets of sketch-solutions may be prepared and the client's attitude to them observed until he is, we hope, finally satisfied.

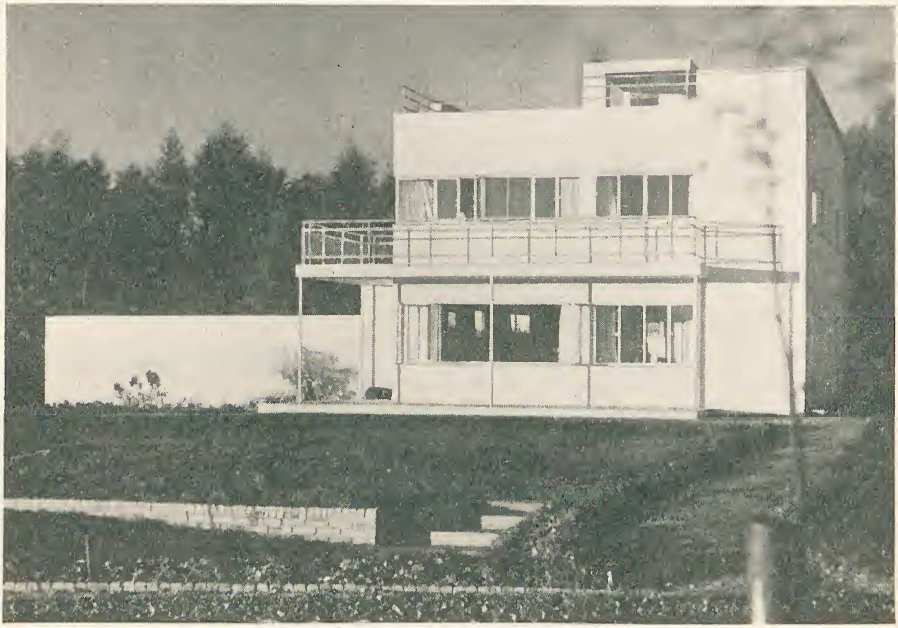


Fig. 4.—HOUSE AT JORDANS, BUCKS

A well-planned house of the modern type. See plans, Fig. 4B. (*Architect : Colin Crickmay, A.R.I.B.A.*)

At these talks, question and answer can elicit such details as requirements as to position ; any sites the client may have in mind ; the money available ; the accommodation and disposition of rooms required. There are, however, other matters for the consideration of which a certain amount of social contact between client and architect is helpful.

Getting the Client's Point of View

First, the architect must sense what his client feels about his home—Is it to be a secluded retreat or the scene of much entertaining ?—this will affect the siting and fenestration, and will suggest, if the former is the case, an unobtrusive building harmonising with its neighbours, or, if the latter, a house prominently placed with an " inviting " exterior and plenty of " circulating " space within. Is the family one in which members have similar tastes, hours, and mutually congenial work and hobbies ?—if so, an open plan of one or two large living-rooms with folding doors between may be indicated, and a good sense of space be thus obtained. Or must the house be planned to suit a variety of ages and pursuits, on more orthodox lines, with smaller, separate rooms ? Has the owner unconventional ideas and habits ?—if so, he will appreciate his architect's suggestions for giving his house a certain uniqueness. Houses meeting such requirements as the above have already been illustrated, and others will be found on the following pages.

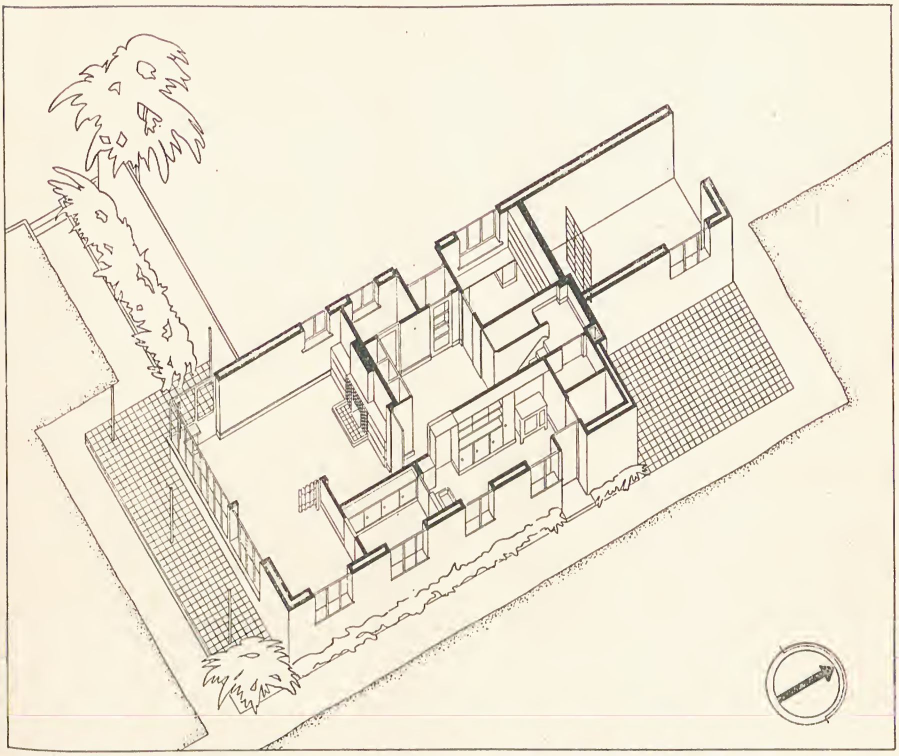


Fig. 4A.—AN AXONOMETRIC VIEW OF HOUSE AT JORDANS, TO ILLUSTRATE THE RELATIVE POSITIONS OF ROOMS, ETC.

Unusual points of view must be studied—as, for example, those of a retired naval officer, who being shown a minimum flat with recesses for cooking, washing, and dressing, remarked that the space was too big and he would always be losing his things in it! The scholarly owner

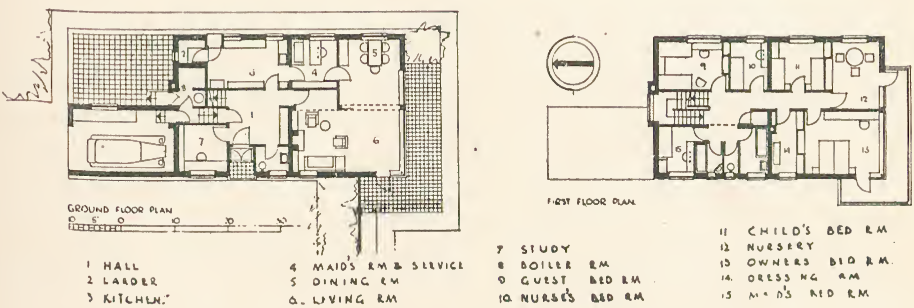


Fig. 4B.—PLANS OF HOUSE AT JORDANS, BUCKS

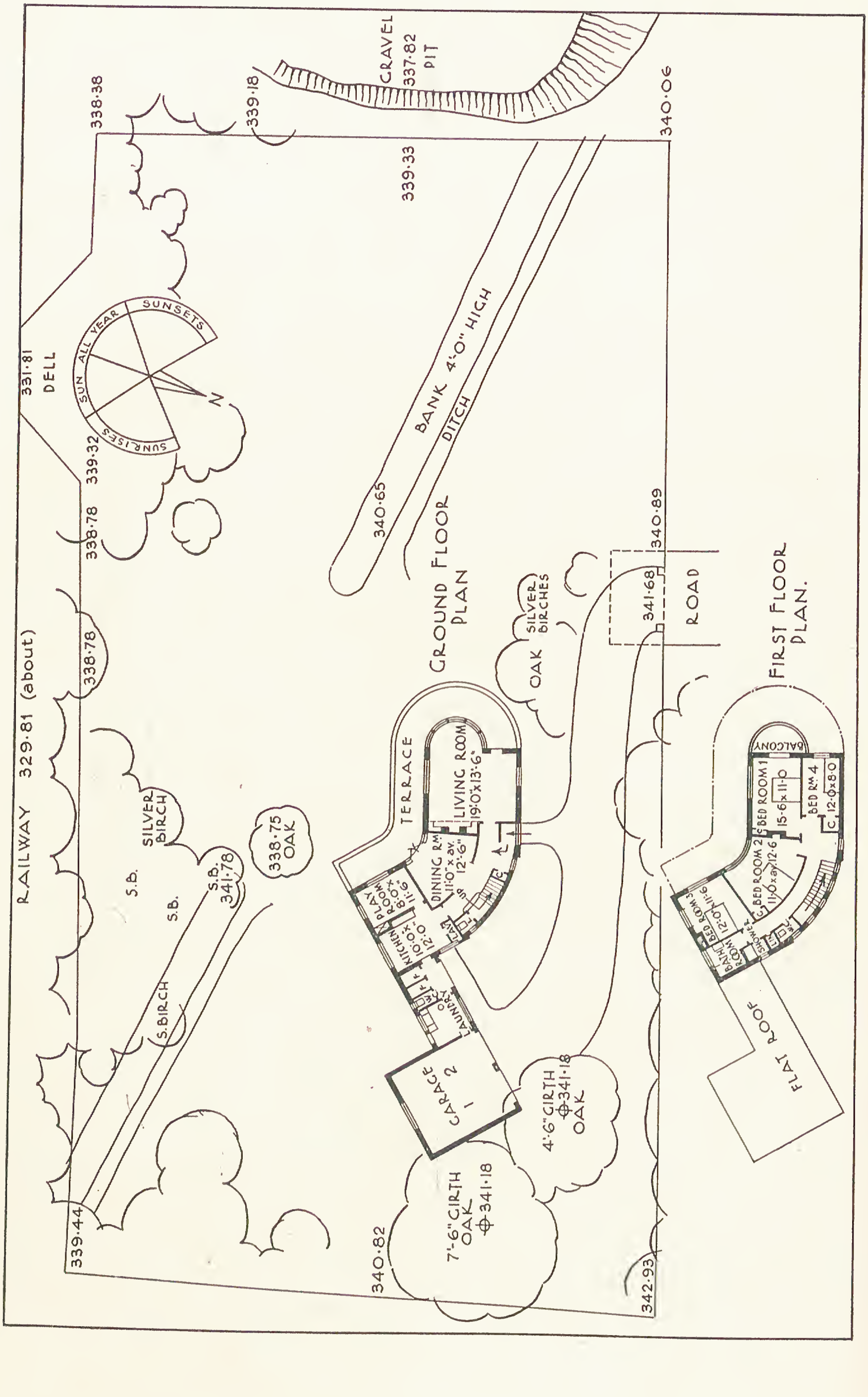


Fig. 5.—SKETCH-PLANS, SHOWING ONLY ESSENTIALS OF ACCOMMODATION AND LAYOUT

of the house at Welwyn Garden City, the interior of which is illustrated (Fig. 6), required most of the ground-floor space for his library, where he works, and it was important to provide for sun in the room throughout the day. An artist with a young family needed a large studio, part of which should be of considerable height—but though studios make delightful living-rooms there must be a separate dining-room, besides a playroom in a rather detached position, so that noisy children's games would not disturb their father's work.

Sometimes an unreasonable prejudice has to be dealt with, as that of the lady who regarded a plan for a four-bedroom house as altogether unsuitable because her architect had contrived a single chimney stack. She explained that a house of this size must have at least two chimneys —so, as the architect was young and anxious not to offend, the house was replanned on less economical lines.

Questions of Taste

Questions of taste arise, and the architect may or may not at first agree with his client, who perhaps insists that the house must be "old-fashioned looking." If he replies that the formal plan which otherwise seems suitable should control the elevation, he may be suspected of shelving the question. It may, however, transpire that his client has lived in a good Georgian house, and that he uses the word "old-fashioned" as meaning the reverse of crude in colour and shape: the architect will be glad to respect such a preference by selecting facing bricks and roof tiles which will mellow quickly, and he will seek to give his building dignified proportions both within and outside. Even what appears to be debased or uncultured taste may be catered for if the designer senses what are the essentials in his client's wishes—if ill-expressed in words. Does he, for instance, appreciate good workmanship or the lines of a well-designed car? and has his wife good taste in carpets, hangings, or dress? If so, there are points of contact from which a distinctive building may emerge.

Economy

The first difficulty which the architect often meets is that requirements in space and fittings are in excess of the resources apparently available. This is sometimes due to the client fearing that the preliminary estimate will be exceeded by the lowest tender—to which must be added unforeseen extras, and to a general feeling that architects are probably an optimistic race of men who need impressing with the need for economy. This may have a grain of truth, though it cannot be too strongly urged that good planning of itself should ensure the best use of the money available. This problem of economy is fundamental to most building projects, and it may be useful if we examine a typical case to see how it may be achieved.

Fig. 6.—APPRECIATING THE CLIENT'S POINT OF VIEW

This library, for a well-known historian, occupies most of the ground floor of the house and, being used throughout the day, has windows in three sides, to secure the maximum sunshine. (*Architects : Mauger & May, A/F.R.I.B.A.*)

The Architect's Suggestions—an Example

First let us imagine a family proposing to leave their home in a town terrace and settle in the country. The requirements for the new house are analysed, and it is found that for £950 a kitchen, scullery, and maid's room, two "reception" rooms, a loggia, one double and two single bedrooms, cloakroom, two w.c.s, bathroom, and boxroom are to be provided. The architect sees that the accommodation asked for is similar to that of his clients' present house, which they are leaving because they find "the place is so poky and depressing," and he notices that the cramped and sunless house has the same effect on himself when he calls. He must evidently provide something more cheerful and spacious. To achieve this he sees that a more open plan is required, and proposes an ample kitchen with a sink recess at one end and a sunny recess for the maid at the other; an adequate south-by-east dining-room, and a large sitting-room with sun from midday till sunset. This reduces the five small rooms to three, each of ample size for its purpose. His client at first hesitates to depart from his original programme, but his

wife soon realises how much more "airy and easy to run" the house will be, and readily agrees. Even she is pleasantly surprised when she moves in, for instead of her old front dining-room, which faced north, and the dull kitchen down a dark passage, she finds that wherever she is in the house, it seems to be sunny. This is, of course, the result of a little forethought as to the aspect of each room by reference to the times of day when it will be normally used. The work of planning embraces many such considerations, and it depends upon the circumstances of each new project as to which should be given most weight.

THE PROPOSED HOUSE EXPLAINED TO THE BUILDER

All the diverse demands of clients must, then, be interpreted by the architect in his drawings and specification. The main object of both is to explain, to the builder, as clearly as possible the design and workmanship required.

Thus it comes about that a standardised style is adopted for them, so much so, in fact, that specification "English" is to laymen a most perplexing literary form. It is, however—like legal phrasing to the initiated—capable of only one interpretation !

The Working Drawings—to what Scale ?

The working drawings give all important dimensions and indicate materials by colour, a system of hatching, or notes. The use of a scale of 8 ft. to the inch is still the common practice in England, though it is the writer's experience that for small-house design this scale calls for a considerable amount of detailing to $\frac{1}{2}$-in. scale. The number of drawings and the repetition they involve can be reduced, and the foreman's work simplified, if the working drawings are to $\frac{1}{4}$-in. scale. More details as to construction, floor finish, fittings, and chases for service pipes can be clearly shown in this way. The modern tendency to equip the house from the start with such items as central heating, electric power, a water softener, and built-in furniture makes it necessary as never before to explain every detail of the building, for the purpose of accurate tendering and the avoidance of confusion in building. This applies particularly where a schedule of quantities is not supplied.

Quotations

Though the builder who is accustomed to carry out large jobs would prefer to work from "quantities" even when pricing a small house, the smaller contractor has no objection to working from a really full specification and set of drawings. In these circumstances it becomes the duty of the architect to see that the work he is asking the invited firms to do in

preparing their quotations shall be simplified as far as possible. The prime cost items should be clearly set out, and the names and addresses of sub-contractors and merchants given, so that four or more estimating clerks may be saved unnecessary correspondence.

Issuing Details

Once the work is begun there must be no delay in issuing the " details " which will be required for solid frames for " building in," and any special brickwork or masonry which is to be carried out at an early stage. Weekly visits by the architect are desirable, and the contractor welcomes them as the best way of furthering the co-operation which all building projects require.

The importance may here be stressed of the need for dimensioning working drawings as fully as possible. The foreman's 2-ft. rule is no substitute for adequate figuring, and as he is required, by the standard specification clause, to take " all sizes from the figured dimensions on the drawings in preference to scaling from them," it is only fair to help him to do so.

Practical Points that May Be Overlooked

It may happen that the architect or his assistant, with so many details to consider, overlooks some practical points in preparing his drawings—such as the need to adhere where possible to brick dimensions or standard scantlings. When the foreman notices such a case and foresees snags for his bricklayers, or unnecessary cost or difficulty in obtaining some special sizes of timber, it is helpful to all concerned if he mentions it to the architect, so that unnecessary work and delay may be avoided.

Information Given on the Working Drawings

Much more information can be given to $\frac{1}{4}$-in. than to $\frac{1}{8}$-in. scale. The former would show the levels of all window heads, sizes of all joists, areas and spacing of ceiling-board sheets (used in lieu of plaster), the lines of all flues, particulars of any special brickwork, positions of built-in light fittings and of all the fixtures, such as basins, boiler, cooker, and copper. To supplement the structural details shown on the sections themselves, larger inset drawings would be given, to a scale of $1\frac{1}{2}$ in. to the foot (or one-eighth full size), of joinery and reinforced-concrete work. Such a drawing leaves little for further " details " apart from the staircase and kitchen dresser. The latter items, which are made at the joinery shop, are more conveniently left till a later stage of the work, so that exact dimensions may be taken of the brickwork before the joinery is put in hand.

Fig. 7.—A COUNTRY HOUSE, WITH LIMEWASHED WALLS, AND A MANSARD ROOF COVERED WITH PANTILES ON THE UPPER AND PLAIN TILES ON THE LOWER SLOPES. (*Architect : Roger Manning, L.R.I.B.A.*)

Fig. 8.—HOUSE IN SUBURBAN SURROUNDINGS ROOFED WITH PANTILES, AND THE WALLS OF STOCK BRICKS LIMEWASHED. (*Architects : Mauger & May, A/F.R.I.B.A.*)

Fig. 9.—WALLS RENDERED WITH "SNOWCRETE," WITH PLINTH OF FACING BRICKS
House at Farnborough, Kent. (*Architect: Roger Manning, L.R.I.B.A.*)

Drawings for Staircases and Dressers

Staircases and dressers can be drawn to ½-in. or 1-in. scale, and full-size details can usually be given on the same sheet.

The Drawings and Prints

It may here be useful to refer to the reproduction of the architect's drawings for the use of the builder. Drawings are now printed quite cheaply by various processes. Contract drawings, copies for the job, and those which are submitted to local authorities for approval, are usually printed on opaque linen or a durable cartridge paper. They are made on a quasi-litho process, and as the printed surface remains dry by this method, the prints are exactly the same size as the original, i.e. "true to scale." For drawings to be coloured after printing this process is desirable. Less-expensive methods are known as "Ozalid," "Dialine," etc. The paper on which such prints are made is thin, and having little "body" is less suitable for colouring or for the hard use to which drawings on the job are subjected. Such prints may safely be used for most purposes so far as accuracy is concerned. The familiar blue print is tending to go out of use because, by reason of the wetting of the print during its development, there is a slight inaccuracy as com-

Fig. 10.—HOUSE SHOWING SUCCESSFUL USE OF PANTILES. (*Architect: F. T. Winter, A.R.I.B.A.*)

pared with the original drawing, and because after a little wear it becomes rough and difficult to read. While most small-scale drawings are done in ink, for permanence and better reproduction, it is possible to get good prints by most methods from a firm pencil-drawing.

Specification

It cannot be too strongly emphasised that a complete specification—no less than clear drawings—is essential to the proper carrying out of the design. Only by a description is it possible to convey particulars of materials and craftsmanship which give the private house the personal character which it should have. Materials, especially those used for walls and roofs, have to be thought out with a view to harmony with the surroundings and good weathering (or mellowing) qualities, and workmanship must be considered in relation to the tastes of the clients.

MATERIALS

For Walls

If the house has a rural setting, the walls may be either of a sand-faced brick or of local stone. Stock bricks—which can be the roughish

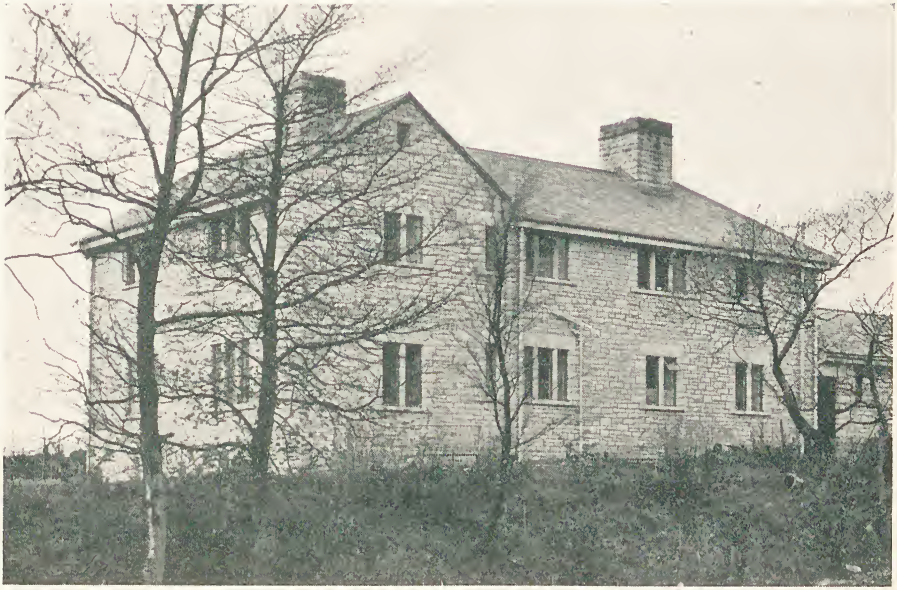


Fig. 11.—This house, in an exposed position, has walls and roof of local stone. (*Architect : the late Edward Unwin, A.R.I.B.A.*)

and fairly uneven seconds—are a good alternative, and the brown and yellow of the walls will give a very pleasant background to the garden and trees. "Stocks" are often limewashed with good results, and if the maintenance every three years or so is not objected to there can be few more suitable finishes for cottage walls. The texture of the bricks is visible, and soft, cheerful colours can be obtained, such as the light pink which has long been popular in east England, or pale green, or the more common cream (see Figs. 7 and 8).

Fig. 12.—The Tolpuddle memorial cottages

Showing the use of straw-coloured concrete tiles. The bricks are light buff local material. (*Architect : the late Edward Unwin, A.R.I.B.A.*)

A Limewash for "Stocks"

A specification for limewash which has been successfully used is as follows :—

1 bush. of fresh-burnt lime.

4 lb. of common salt.

½ gal. of boiled linseed oil.

The lump lime to be put in a barrel and slaked, boiling oil added and well stirred, and salt added while stirring. Strain the mixture when cool.

Use in the ordinary way and thin as required with water. There is no need to add any petrifying fluid. If colour is too white, yellow ochre or other colour may be added.

Objections to Rendering

The use of a rendering on a solid wall is generally not recommended, on account of the practical objection that if cracks occur and moisture penetrates the brickwork, the impervious rendering prevents it drying out. There is in some circumstances, also, an æsthetic reason against using a finish which is liable to look hard and mechanical if given a smooth surface, and rather messy and shapeless if a dashing of spar or gravel is applied to give it "texture." A wood-floated finish of "Snowcrete" or blue lias lime, however, gives a pleasant effect, and can be limewashed or distempered.

For Urban Houses

For urban houses a more "mechanical" brick, ashlar masonry, or concrete can be used. The concrete surface should either be left from wood or serrated-metal formwork, or be given a wood-floated or scraped rendering of one of the coloured cement mixtures.

Flat Roofs

If a flat roof is used, the walls should be kept fairly light, and concrete, stock bricks, limewash, or a rendering will be suitable except that an applied finish will require renewal in town or suburb more frequently than in the country.

Materials for Pitched Roofs

For a pitched roof there is a great variety of possible coverings, which should be considered in relation to the walling material. Sand-faced bricks suggest tiles of a similar colour, though if the tiles are rather brighter than the walls they may still be used, since good roofing materials "weather" quickly to a rich tone.

Use of Pantiles

If the pitch be less than 40° it will be advisable to employ pantiles, which were until lately mainly confined to farm outbuildings. For large

roofs of whatever pitch there is a pantile to suit almost any brick—yellow and grey made in Essex, red and brown in Berkshire, and purple-brown or blue in Staffordshire. It should be remembered that where tiles are laid over felt it is undesirable to torch or point the bottom of tiles from inside, on account of the danger that the lower surfaces may flake if free air is excluded. They can, however, be invisibly pointed down the vertical joint if a wood fillet be fixed behind the roll of the tile. Pantiles call for a gabled rather than a hipped treatment, because hip tiles look clumsy when raised above the adjacent rolls of the tiles. This objection is lessened by the use of a " trumpet "-shaped hip.

Use of the Plain Tile

The plain tile can be used for almost any type of roof provided the pitch is sufficient, and the well-known bonnet hip and purposely made valley tiles are important elements in any roof of the kind.

Roof Covering for Stone Houses

For a stone house it should be possible to find a thick slate of a texture similar to or rather coarser than that of the masonry. It need hardly be explained that tiles should only be used on stone buildings after careful consideration of the effect they will produce. Certain types of grey and green slates can, however, be successfully combined with brick walls of a neutral or yellowish colour.

Use of Concrete Tiles

Recently, concrete plain tiles have been much used in less expensive work. They can be obtained in some pleasant colours and are not unsuitable for urban work. Their more mechanical shape, as compared with the burnt-clay tiles we have been considering above, makes them rather less suitable for country houses. It must be added, however, that where a tile is required for a building near old thatched roofs or lichen-covered walls there can be few more appropriate roofing materials than the yellowish-brown concrete tiles used by the late Edward Unwin on the Tolpuddle Memorial Cottages.

We have now considered the specification of walls and roofs from the aspect of their part in the design of the house, and it should be borne in mind that the specification writer, who deals with these and many other kindred questions, may contribute greatly to the beauty of the building.

THE SPECULATIVE BUILDER AND THE SMALL HOUSE

IT is not the intention of the writer to indulge in indiscriminate abuse of the speculative builder, in this brief article. The jerry-builder, both of fact and of fiction, we all condemn, but the speculative builder is not necessarily an unscrupulous tradesman. It is quite possible to carry out speculative building as honestly and as soundly as any other form of construction.

It is stated that a large percentage of the total building in this country is carried out without the supervision of an architect, and there is little doubt that most of this work is in the nature of the small house.

The writer considers that the speculative builder has supplied in the past, and does still supply, a much-needed requirement in the shape of a small house at a reasonable price, though there is great variation in the class of work done by the different firms. No purchaser can reasonably expect all the materials and workmanship to be of the first quality at the price quoted. If he is unfortunate enough to fall into the hands of an unscrupulous man he has only himself to blame if, after a few months' residence, a number of defects come to light. It is rare for a possible buyer, when contemplating the purchase of a small property, to call in the services of an architect or surveyor and instruct him to inspect and report upon it. Yet the same man would, if he were considering the buying of a car or a piano at only one-tenth the price of a house, request an expert to give some opinion as to its value.

The alteration in type of the builder's speculative house during the last forty years or so has been revolutionary. Where at one time the speculative builder erected "back-to-backs," or small "throughs"—which means a terrace, in these days it is always, or nearly always, what the agents call an "S.D." or semi-detached.

Old Style—"Back-to-back" Types of Houses

The back-to-back house was usually built in a block of eight, the cheaper type often being close to the pavement. The frontage was generally 18 ft. to 19 ft. centre to centre, the depth or "over-all" of the two being 30 ft. Fig. 1 gives an idea of the arrangement. The accommodation consisted of a living-kitchen and scullery, two bedrooms above, and an attic ; also basement with larder and coals. The lavatory accommodation was outside, being erected in an open space of 15 ft. between

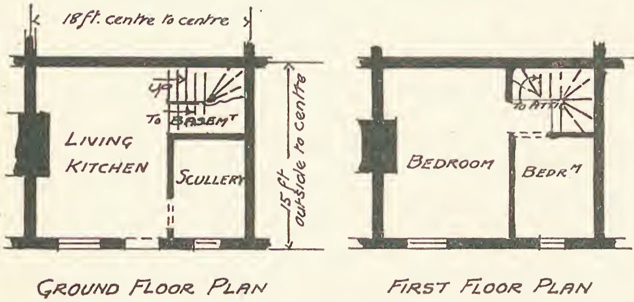


Fig. 1.—THE SMALL HOUSE OF FORTY YEARS AGO —THE "BACK-TO-BACK"

two blocks, and one w.c. was provided for two houses. Fig. 2 shows the blocks and general layout.

It might here be observed that in the general layout of back-to-back houses no regard whatever was paid to aspect, and it is quite obvious that in a street running east and west the houses on one side would obtain no sun except a small quantity in the height of summer.

A little better type of back-to-back was one with a small front garden of, say, 9 ft. to 15 ft. in width, and usually the ground floor was well above ground level, often a wash-cellar and w.c. being provided in the basement.

At this stage it might be mentioned that the first type often meant a density of sixty per acre. Compare this with the regulations of to-day, when twenty per acre is a rarity.

The back-to-back house was usually sold in blocks of eight, not to occupying owners, but usually to people who purchased them as an investment.

The "Through" or Terrace House

The plan of the "through" or terrace house (Fig. 3) is one of the better type, with a passage—for it cannot be called a hall, whereas in the cheaper type the entrance from the street is direct into the room. Invariably the staircase was between the two walls. The accommodation varied a little, usually a front room or parlour, kitchen, possibly a scullery, two or three bedrooms, perhaps a bathroom, and there might or might not be an attic. Probably half the area was cellared for coals and larder. This was a very popular type of house, but one of the worst features was often

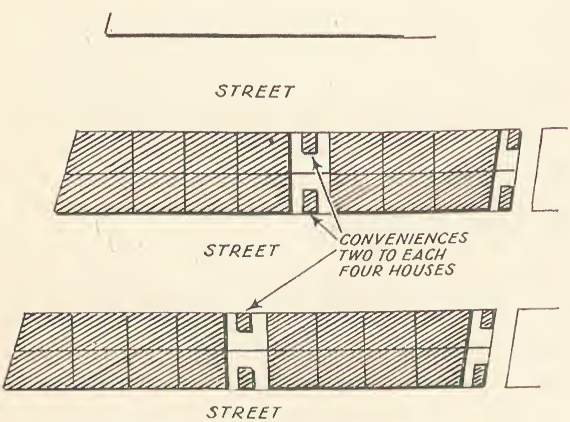


Fig. 2.—LAYOUT OF BACK-TO-BACK HOUSES

a narrow back garden with a w.c. and an ash-pit at the rear end, abutting on to a back street 12 ft. or 15 ft. wide. The reader will readily appreciate the unpleasantness of these back streets, flanked by a monotonous series of what at one time were earth-closets, though sometimes converted into w.c.s or ash-pits. The same remarks as to aspect apply equally to the terrace house as to the "back-to-back" type.

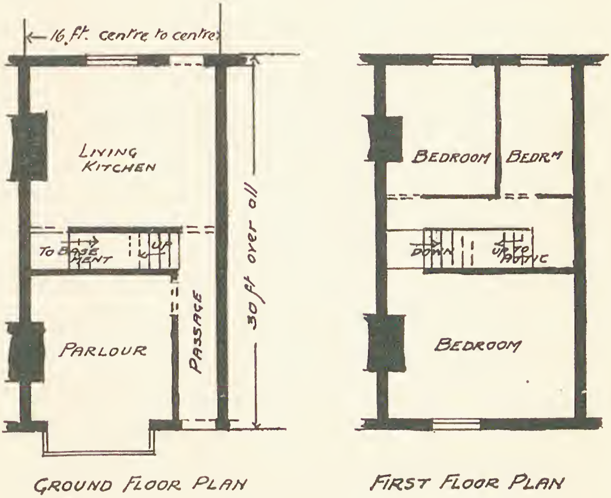


Fig. 3.—TYPICAL SMALL TERRACE HOUSE

The above brief description will emphasise strongly the difference between the dwellings before mentioned and the small house of to-day.

Modern Style—the Semi-detached House

Perhaps the most important reason for the prevalence of the modern semi-detached house is the increase in the number of occupying owners. Owing to the house shortage immediately after the Great War, the only way to obtain a dwelling quickly was to buy one, and as there was a ready sale for all houses, the builders took advantage of this and at once set to work to make good the shortage.

What is "the Speculative Builder"?

By the term "speculative builder" we do not mean the mere financier who simply capitalises an enterprise. There is the large firm or limited company who will take a big area of land and carry out an extensive scheme, perhaps twenty or more blocks going up at the same time. There is also the small man who carries on on a lesser scale, and who has perhaps not more than three or four blocks in course of erection at one time. As a rule, this type of builder has his own staff of bricklayers and joiners, but he will let by contract the other trades, such as slating, plastering, plumbing, painting, and electrical work, to small specialists in these trades, often the type of man who takes his own coat off and works alongside with, perhaps, one journeyman and an apprentice.

In all possible cases, the builder buys his manufactured joinery, such as window frames, doors, and often the stairs, from one of the firms who

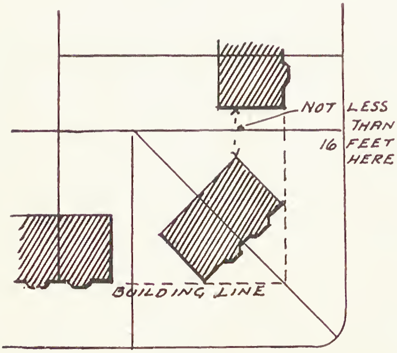


Fig. 4.—A CORNER SITE IN A SEMI-DETACHED HOUSING ESTATE

make a speciality of these things, so that the work of his own staff of joiners is confined to fixing.

Show-house Selling

A board is soon put up at a prominent point on the estate, giving the name of the builder, with the price of house he intends to erect, and invitation to view; and, of course, it is very encouraging if sales can be made whilst the buildings are in course of erection. Also it is the custom, as soon as one house is completed, to have it painted and generally "poshed up," with a board advertising the "show-house," inviting all and sundry to come in and look round. Naturally the show-house is well finished. An amusing story is related concerning one estate. The builder was not too scrupulous in his methods, and one purchaser, after occupying his house for two or three months, was extremely dissatisfied. There were many defects and complaints, which the builder refused to rectify, so, taking advantage of the fact that people had to pass his house in order to view the other houses which were for sale, he exhibited a board, displaying in large lettering these words, "*Before visiting the show-house come in and see this.*" Needless to say, before the week was out this gentleman's complaints were attended to, and the offending board removed.

Layout of the Semi-detached Housing Estate

Notable features in the layout of an estate to-day are the decrease in density and the elimination of the back street, though in the old days these may have been admitted as part of the natural order of things. Even if the development of the estate to-day may not be all that can be desired, it can scarcely be contradicted that it is a great advance upon the style of thing carried out forty years ago.

The modern fashion of always placing a pair of houses at an angle of approximately 45° when going round the corner has two good reasons to recommend it: first, the avoidance of an unsightly end in juxtaposition with the front; and second, the lessening of road charges to the buyer of a corner house. At the same time it must be admitted that it is difficult to give a fair share of garden to the occupants of these corner houses, as the gardens must inevitably come to a point. Fig. 4 will illustrate this.

Typical Semi-detached Plan—the "Five-fifty"

Fig. 5 is a plan of the type of house which seems to be most popular to-day, what is called a "five-fifty," or in other words, built to sell at £550 or thereabouts. One sees so many of this pattern that the

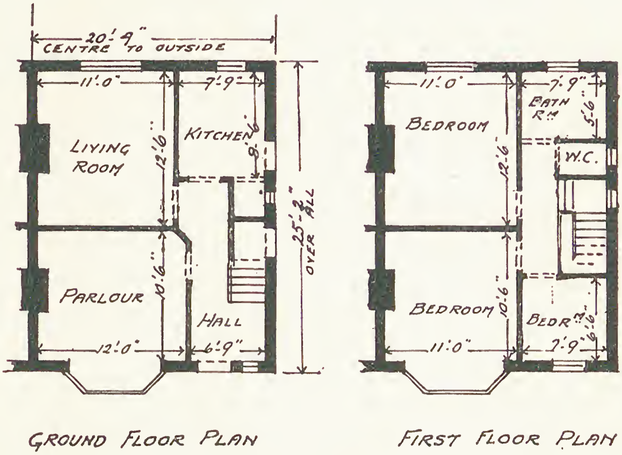


Fig. 5.—A TYPICAL PLAN OF A " FIVE-FIFTY " SEMI-DETACHED HOUSE

plan can be described and sketched from a mere glance from the outside, viz. a decent-sized room with a bay window, a hall about 6 ft. wide with stairs facing you on entering the front door, a rather smaller back room, and a small working kitchen or "kitchenette." The larder will be partly under the stairs, and coals under the other portion, access to the fuel being obtained from outside the house. Upstairs there will be two fairly good bedrooms, one smaller bedroom, a bath-room, and a w.c. This plan is somewhat elastic. If a prospective purchaser would like the living-rooms to be a little larger this can be done, and incidentally a proportionately increased price is demanded. This plan may also be compressed if the house is required to be sold at a lower price. The depth of building line will vary from 15 to 20 ft. at the front ; in the rear there will be 30 ft. or so of back garden, according to the circumstances of the site. The side roads are not less than 6 ft., although 8 ft. is better, as a garage may possibly be required. It must be admitted that this is a good, sound plan, and is undoubtedly very well liked by the general public.

In nearly all cases the entrances are on the outside of each pair, the rooms abutting. This makes for economy, as the builder is thus enabled to get his chimney flues into one stack, and also may serve to keep the main rooms warmer. The disadvantage of this is that the wireless of the neighbour is more likely to cause annoyance.

One disadvantage in this type of house is that as the kitchen does not contain a fireplace, the fire-back boiler for providing the hot-water system has to be fixed in the living-room, and thus, to ensure the necessary supply of hot water, a fire must be kept going in this living-room, even in the summer time. Of course, an electric immerser or a gas geyser can be installed, to work in conjunction with, or independently of, the fire-back boiler, but this is not a usual part of the equipment provided by the builder.

Larger-house Plan

Naturally, when the plan is stretched a little, and a larger type of house erected, to sell at, say, £650 or thereabouts, the kitchen in this case is furnished with a fireplace and a fire-back boiler.

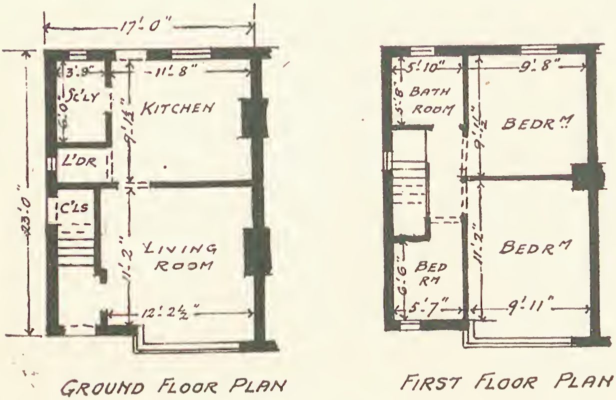


Fig. 6.—A TYPICAL SMALLER HOUSE

The plan can be extended so much as to give a desirable and useful house even up to a price of £650 or £700, all the rooms being distinctly larger, and of course fittings and fireplaces of a better quality, and probably the site somewhat better.

Smaller-house Plans

The plan also may be compressed, but this is more difficult. Obviously, if it is desired to erect a house to sell at £450, the same size cannot be given. The staircase will require nearly as much space. In the "five-fifty" type, the larder, coals, etc., are already at the minimum. The planning calls for great ingenuity, and we give here plans of types of houses erected and sold at £400 to £430.

The accommodation in Fig. 6, as far as the number of rooms is concerned, is similar to that in the "five-fifty"; but it is not quite as convenient. The hall is entirely eliminated, the bedrooms are not provided with fireplaces, and the w.c. is in the bathroom. All the rooms are very much smaller, and a minor inconvenience is that the way to the kitchen is through the front room.

An alternative plan of this type of house is given in Fig. 7, where this latter objection is avoided by the main or front entrance being placed at the end. Then the size of the bathroom is very substantially increased by projecting the floor over the main entrance. This somewhat ingenious trick allows the small bedroom to be appreciably larger.

Methods of Reducing Cost

The various points which enable this type of house to be erected and sold at a lower price are :—

Whereas our typical "five-fifty" house covers an area of somewhat over 500 super. feet, the types shown in Figs. 6 and 7 occupy only about 400 super. feet. Not only this, but most probably this class of house will be erected in a district where a greater density is allowed, possibly twelve to the acre. This naturally means that the cost of land and road charges is only about two-thirds of the amount required by the ordinary type, and in all probability the site will be less costly.

In the actual house itself there are many items on which capital outlay is saved, such as bedroom fireplaces, which also mean smaller chimney

flues and stacks, no separate w.c., which saves a partition, a window, a door and its fittings.

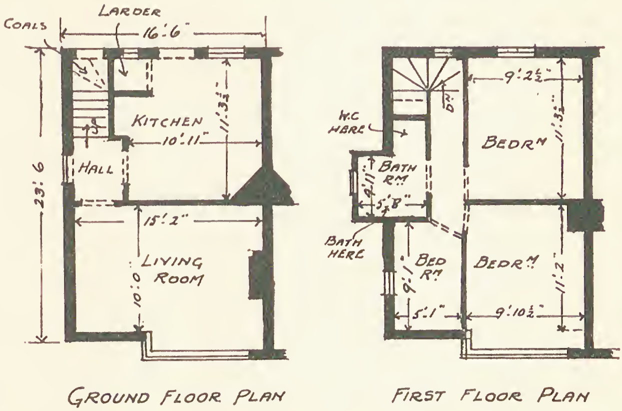


Fig. 7.—ALTERNATIVE PLAN FOR A SMALLER HOUSE

Features of Design—the Bay Window

One feature of the design of nearly all these houses of the semi-detached type is inevitably the bay window.

The writer has heard many arguments against the bay window, such as, that it is expensive to build, also expensive for the housewife to curtain ; that it is often a source of trouble with the roof; that the large area of glass tends to make the room colder. It is also argued that to give an extra 18 in. to the length of the room would more than compensate for the additional space lost by the elimination of the bay. Yet, in spite of all these arguments, the bay window retains, and probably will continue to retain, its popularity. As one builder put it to the writer, " the public are bay-window mad." Probably the reasons for this partiality to the bay window are that it commands a more extended view, and that it affords the housewife an opportunity to display a few plants and flowers. So we get bay windows of all types—square, canted, circular, and pentagonal, though as a rule the canted or angular one is the most popular. In numberless cases the bay window is carried up to the roof, so that the bedroom above is also enhanced by the addition of a bay. Generally it consists of a five-light window, three on the front, and one on each return, whether square or angular. Occasionally the lop-sided bay window is employed, that is, the two bays joining up as in Figs. 6 and 7.

One must here note the quickness of the speculative builder to grasp any new suggestion or idea. The writer remembers a case, several years ago, in a district where the speculative builder was busy, an architect designed and erected a house. In all cases the windows of this house had side-hung casements. Within two years every builder in the district had discarded the sliding sash and adopted the side-hung casement. At the present time, we never, or scarcely ever, see a house of this class erected with anything but the casement window, and we can meet joiners who have never made a sliding-sash window.

Flush Doors and Staircase

The builder to-day has been quick to adopt the flush door, and to eliminate the staircase balustrade, the space between the handrail and steps being filled in with plywood.

In another matter, the builder is somewhat conservative. Many cases may be seen where, in order to utilise the site to its fullest extent, and complete the estate, there is space left for a detached house. In many of these cases this detached house is not designed as a separate entity, but might be described as half a pair. Undoubtedly it is more economical, but it certainly cannot be said that this is making the most of an opportunity.

Wall Construction

The 11-in. wall, with a 2-in. cavity, seems to be the standard, a 9-in. solid wall between the two houses, and of course all the internal walls 4½ in. or half-a-brick thick. Upstairs, in many cases, the whole of the internal walls, or partitions, are 3-in. breeze slabs.

Often the construction of the bay windows leaves much to be desired. It is quite common to find the floor joists of the upper bay window simply carried by the framework of the lower bay, and though one is not apprehensive of a serious accident occurring, certainly this cannot be commended. It most decidedly gives rise to the thought that if a heavy dressing-table be placed in the bedroom bay window, the lower windows will be apt to jam. The space between the head of the lower bay and the cill of the upper one is usually finished externally with either tiles or lath and plaster, according to the design of the house, a point we shall mention later.

Sanitation

Referring to such important matters of construction as drains, sanitation, etc., the public may be considered as being safeguarded by the local authorities, and the same remark applies to the depth and solidity of foundations, the provision of air-grates, and all such-like matters.

Internal Finish

The internal finish is usually of the simplest character: two coats of plaster, the wooden angle bead to all external angles, a plain coved cornice to the two rooms, and very simply moulded architraves and skirtings. It is needless to remark that all floors are constructed of joists and boards, except perhaps the small kitchen, coalhouse, etc., which are commonly of concrete.

Monotony of Appearance

Unfortunately, in these days of mass production there is a great monotony of appearance in many of these speculative schemes. We can

readily appreciate the difficulty of a builder, who is endeavouring at the same time to give good value for money, and to keep his price as low as possible, yet who desires to avoid the uniformity of twelve pairs of houses all exactly alike.

The heights are very much the same, and it is obvious that any builder will keep his rooms as low as the local by-laws will allow. Generally 8 ft. is the minimum. Therefore a level site will keep his efforts very much in line.

Brickwork or Half-timber ?

Of course, bricks are the usual materials for the walls, the cost of stone rendering it out of the question, except perhaps in a few cases of better-class houses. In the old days, the exterior walls were generally faced with pressed bricks, common stocks being used for the rear elevations.

After the architects and professional designers commenced the practice of employing half-timber and stucco, the builder was quick to follow, and in some cases with very disastrous results as far as the artistic appearance was concerned. The half-timber was often very unsightly, badly designed, and the " rough-cast " crude. Half-timber, however, has not been so much used in later years, but plaster still holds a strong place. At one period it was so difficult to obtain a steady supply of good facing bricks, that many builders were almost compelled to utilise plaster for the upper portion, at any rate, in order to " get on with the job." An unfortunate result is that so much dull grey plaster has contributed largely to a monotonous and dreary appearance in many cases.

Certainly, at one time, the public appeared to appreciate the houses of half-timber or plaster, but latterly there has been a great tendency on the part of the purchaser to return to plain brickwork, as he has seen many examples where the plaster has not worn well, or has become unsightly. He feels also, and probably rightly, that there is likely to be less cost of upkeep with plain brickwork, than with a front of timber and plaster, which will require repainting or recolouring every few years.

The pressed brick is no longer supreme. Thirty years or so ago an architect's specification always read " the bricks to be sound, hard, and of uniform colour," but now " rustic," " sand-faced," and " multi-coloured " bricks are largely employed, and the builder has been wise enough to follow. To an observer with artistic feeling, the texture of sand-faced bricks, with their variety of colour, ranging from nearly black, through purples, reds, browns, to a straw colour, when mellowed somewhat by time, gives a more pleasing effect than the even redness of the pressed brick.

Typical Front Elevation

The plans of our typical " five-fifty " house being already given, it follows that the elevations will have, more or less, a certain sameness. In Fig. 8 we show a typical elevation. The usual type of roof is the hipped

Fig. 8.—Elevation of a typical pair

one, which unhappily often gives the impression of a box lid. Gabled roofs would probably be more objectionable, besides interfering appreciably with the light to the side windows of the neighbouring houses. So, to avoid absolute uniformity, small changes are effected by means of different types of bay windows, the square, the canted, or the circular. Also, some pairs may be plastered from the level of the ground-floor cills, others from the first-floor cills, the space between the bays being plastered and tile-hung alternately.

Roofs

For the roof there is, of course, the blue slate (the green Westmorland is far too expensive), tiles either red or mottled, or brightly coloured pantiles. Another innovation of the last few years is the concrete tile. When natural colours are used it is quite effective, but the brighter colours manufactured to obtain a mottled appearance seem to wear off very soon, and even at first the contrast of a bright green with yellow ochre is not at all pleasing.

Entrances

The entrance gives some scope for variety in a small way. It may have a tiled hood, as shown in Fig. 8, or veranda carried along from the bay window. A flat hood of timber covered with felt, supported by two shaped brackets, may be introduced. Or again, this hood may be a large concrete slab on a pair of brackets. The modern "soldier" arch has become very popular for the heads of all flat windows, and cills are usually brick on edge, bull-nosed in some cases; in others a lower wooden cill only is used.

Varying the Elevation

We show in Fig. 9 a rather more ambitious elevation. Here the entrances are slightly recessed from the main wall, which gives an opportunity for introducing a double gable at the front, the outer slopes being carried down nearly to the first-floor level. But note the effect caused

by this. Clearly, for these gables to project in the manner shown, a small portion must be cut out of the hall, and, what is more important, out of the small bedroom above. It is very plain, however, that even if the hall can afford this loss of space, the bedroom above, only 6 ft. 6 in. in our typical plan, cannot afford to lose any space

Fig. 9.—AN ALTERNATIVE ELEVATION

whatever; therefore, to all practical purposes, it is not a case of the entrances recessed, but of the main rooms being brought forward 14 or 18 in. This automatically becomes a consideration. Also, the gables are a source of additional expense on account of more walling, more labour and material for the joiners, valley gutters, cutting and wastage of slates or tiles. So it appears to be very evident that this type of elevation can be carried out only when a better price is likely to be obtained.

Also, in this design there is another point to be considered, viz. the window of the small bedroom. This cannot be at the front, as the slope of the gable will not allow it, therefore this window must be placed at the side. But if every pair of houses is designed in this way the windows of the small bedrooms would be exactly opposite each other, at a distance of about 16 to 20 ft. Probably the best method of employing this style of elevation would be to introduce it occasionally between pairs of the typical pattern shown in Fig. 8.

The Double Bay

Another variation is what may be termed the "double bay," that is, the two bay windows joining up with each other as shown in the small houses Figs. 5 and 6. This makes for economy in the roofing, and also avoids the overlooking of two windows near together, as was described above.

Varying the Side Elevation

Certainly the builder might attempt a little more design in his side elevations. We show in Fig. 10 the end of a rather better type of house,

where the kitchen and sitting-room chimneys project from the end wall. The Fig. shows the manner in which these chimneys were actually erected. In the first place, the single-flue chimney stack is very unsightly ; secondly, the offsets are too flat ; thirdly, the eaves gutter appears to cut the stacks in two ; and fourthly, these two stacks each required an iron stay-bar. If a little more thought had been expended, and the chimneys erected in one stack as suggested in the second sketch, it should not have been any more expensive. Though there would be the labour required in the construction of the arch, and more tiled offsets, yet an amount of brickwork would be saved, and with a larger stack the unsightly metal stay-bars would not be necessary. Further, a most decided economy would be effected in the labour required in erecting the scaffolding for only one stack instead of two.

Harmonising with Surroundings

The use of materials which do not harmonise with the surrounding country must be strongly deprecated. In a rugged, hilly district, red brick and red tiles are entirely out of place, as witness the recent outcry against the glaring examples of this in the Peak District of Derbyshire. In many cases a more objectionable material than red tiles has been employed, viz. asbestos slates, which, with their brilliant colour, are entirely unsuited to these surroundings.

The Modernist Style

The modernist style, or sunshine houses as they are often called, with flat roofs, is only occasionally used for these small houses by the more enterprising of our speculative builders, as there seems to be a doubt as to whether this style will appeal to the taste of the small owner.

Making Decisions as to Price

The speculative builder has to make up his mind, at a very early stage, as to the class of house he intends to erect, and the price he expects to obtain in order to allow a reasonable margin of profit. In fixing this he must consider the figure his competitors are selling at, and what value they are giving. It is a very common method for a builder to fix what might be termed a basic price, and advertise the property as " road charges included," and also a free conveyance. Usually the building society, or whoever may be backing him financially, retains part of the loan to cover road charges. With regard to fittings, such as fireplaces, most likely they will not be fixed until the house is sold, the purchaser being informed of the amount included for these and allowed to select them himself. Commonly, the basic price will include simply an ordinary finish, such matters as leaded lights, a tiled bathroom, or a tiled kitchen being quoted and agreed upon as definite extras.

Choosing a Site

A good deal of judgment is needed in the choice of a site for any speculative enterprise. If the scheme is only a small one, a builder may find a site for one or two pairs where no roadmaking is needed, but if he is working on a larger scale it is scarcely probable that he will discover a plot of ground to take twenty pairs or more of houses without having to make application to the local authorities for some sewering, kerbing, and roadmaking.

To be a really profitable scheme there should be absolutely a minimum of new roadmaking. Again, can the whole of the site be utilised without more than the smallest quantity of new roads ?

Not only should the subsoil be fairly solid, so that the foundations need not be more than normal depth, but is it reasonably level, or at any rate are the gradients uniform, and not too steep ? It is quite apparent that each pair of houses must be on the same level, and it is equally apparent that if the gradient be steep one house will require a quantity of walling below the ground-floor level.

Are the main sewers of sufficient depth, yet not unreasonably deep ? And are the water, gas, and electricity services easily available ?

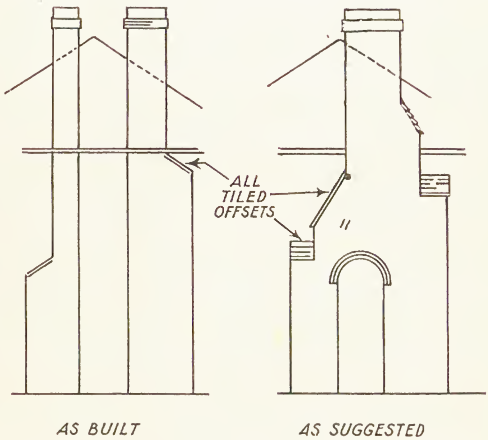


Fig. 10.—End chimneys

When all these matters are settled in a satisfactory manner, there is still the possibility of finding bad patches in the foundations, where sections of walling may have to be carried down 6 or 8 ft. One can recall cases of this kind where perhaps the foundation of one wall is only 2 ft. below the floor line, and an adjoining one may be 6 or 7 ft. lower.

Problems while Building

Whilst building, there is always the problem of the builder's old enemy, bad weather, to consider. Delayed completion, broken time for the workmen, all have a tendency to lessen the hoped-for profits. And finally, is the enterprising builder going to be fortunate in getting a quick sale ? It is clear he will be exceptionally lucky if he can sell before his work is completed in all cases. Very commonly, after one or two houses are occupied, they serve as " show-houses " for the whole estate, but unfortunately, at times, the builder, after clearing the bulk of his property, may be left for weeks or months with two or three empty houses on his

hands, and possibly, in order to dispose of them, may be compelled to reduce his price considerably.

As a rule the builder is averse to letting his property, and much prefers to sell outright, as it releases his capital for the next venture.

Margin of Profit

Regarding the margin of profit to be obtained, this will depend upon the circumstances before mentioned, though in many cases it is no doubt very small. One builder whose speciality was the terrace house, selling approximately at £275 (this was in pre-war days), told the writer that if he could clear £5 per house he was satisfied. He also stated that in the previous year he had built and sold sixty houses ; at the same time this seems a very small margin of profit, and not at all commensurate with the risks undertaken.

Aids to Selling

Naturally the builder does all he can to induce the purchaser to buy. At one time the road charges were not reserved ; now, as previously stated, this is invariably done. Also in many cases the builder will carry out the decoration of the house, papering, etc., the purchaser selecting his own paper up to a certain figure per roll, paying any extra cost out of his own pocket if he desires a better-quality paper than the one allowed for. Some builders go even further than this, and include a kitchen cabinet or other useful fitting.

A considerable contribution towards the success of the speculative builder and the housing boom generally has been made by the building societies, particularly in later years. A normal advance by a building society to a would-be house-owner has always been considered ample at 80 per cent. of the value of the property, but in recent years, in order to meet the requirements of people to whom the 20 per cent. balance was an appreciable sum, building societies have worked out a scheme whereby an advance of 90 per cent. has been made, subject to the town or borough council or an insurance company guaranteeing the extra 10 per cent.

Building Societies' Pool Scheme

A still more recent development has been the " pool " scheme of the building societies. By these schemes, an advance of 95 per cent. is made to house purchasers ; an account is opened in the builder's name by the building society, which is called the " pool " account, and into this account the builder pays an agreed sum, varying from £30 to £40, every time a sale is concluded, as a collateral deposit. This " pool " account is retained by the building society until the house purchaser has reduced the amount of his mortgage to the normal 80 per cent., which takes a period of some years. During this period the account is earning interest for the builder, usually about 3 per cent., and at the end of the period the whole

amount may be withdrawn by the builder. But during the period, should any householder fail to meet his obligations, then the " pool " may be " raided " by the building society to meet any loss sustained by them.

Usually there is a minimum and a maximum amount fixed for the " pool," according to the size of the estate, but it will be seen that in a very small scheme the " pool " system is not workable, and is only feasible in a development scheme of a reasonable size.

In conclusion, though the speculative builder may often be the butt for witticisms and also for more serious criticism, perhaps well deserved, yet at any rate he has in the last fifteen years or so provided the public with many useful and convenient houses, and is thus justified by the value of his services.

QUESTIONS AND ANSWERS

What is meant by a " Five-fifty " House ?

The popular type of semi-detached house built to sell at £550 or thereabouts.

What are the usual features of a " Five-fifty " House ?

(1) Front room with bay window.

(2) Hall about 6 ft. wide, with stairs facing front door.

(3) Back room slightly smaller than the front room.

(4) Small working kitchen or " kitchenette."

(5) Larder under stairs.

(6) Sometimes the coal space is also under the stairs, access being obtained from outside.

(7) Upstairs : three bedrooms, one small ; a bathroom, and a w.c.

Why are Entrances usually placed on the Outside of each pair of Semi-detached Houses ?

As the rooms abut, the builder is enabled to get his chimney flues into one stack, thus making for economy.

How may Houses be designed to sell at a Price Below £450 ?

(1) By eliminating the hall.

(2) By eliminating fireplaces in bedrooms.

(3) By placing the w.c. in the bathroom.

(4) By decreasing sizes of rooms.

What is the usual practice with regard to the Walls of Semi-detached Houses ?

Eleven-inch wall with a 2-in. cavity, a 9-in. solid wall between the two houses, and all internal walls $4\frac{1}{2}$ in. or half-a-brick thick. Upstairs, the whole of the internal walls, or partitions, are often of 3-in. breeze slabs.

How are Floors usually constructed ?

Of joists and boards, except perhaps the small kitchen and coal house, which are commonly of concrete.

What is the Double-bay Window ?

Two bay windows joining up with each other.

What are the advantages of the Double-bay Window ?

(1) Economy in roofing.
(2) It avoids the overlooking of two windows near together.

How is a Corner Site usually treated in a Semi-detached Housing Estate ?

A pair of houses is placed at an angle of about 45° when going round the corner.

What are the Reasons that Recommend this Practice ?

(1) The avoidance of an unsightly end in juxtaposition with the front of a house.
(2) The lessening of road charges to the buyer of a corner house.

What Objection is there from the point of view of a Buyer of a Corner House ?

The garden is smaller than that given to the occupants of the other houses in the estate.

What variety may be introduced in the Entrances of typical Semi-detached Houses ?

It is possible to use the following variations :—
(1) Tiled hood.
(2) Veranda carried along from the bay window.
(3) Flat hood of timber covered with felt, supported by two shaped brackets.
(4) Concrete slab hood supported on pair of brackets.

PLANNING AND DESIGN OF SCHOOLS

PART I.—GENERAL PRINCIPLES, HALLS, CLASSROOMS, AND WORKSHOPS

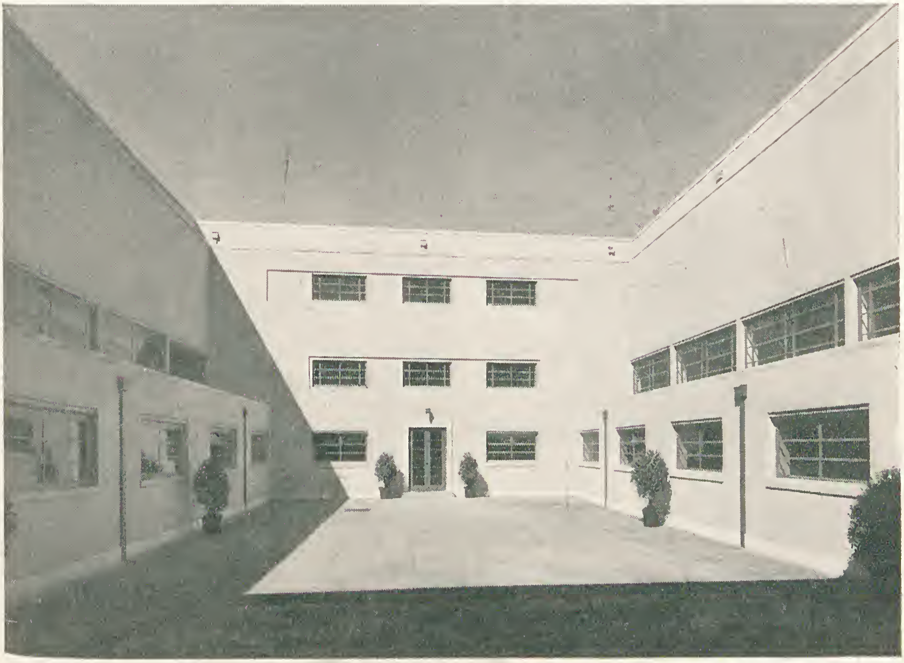
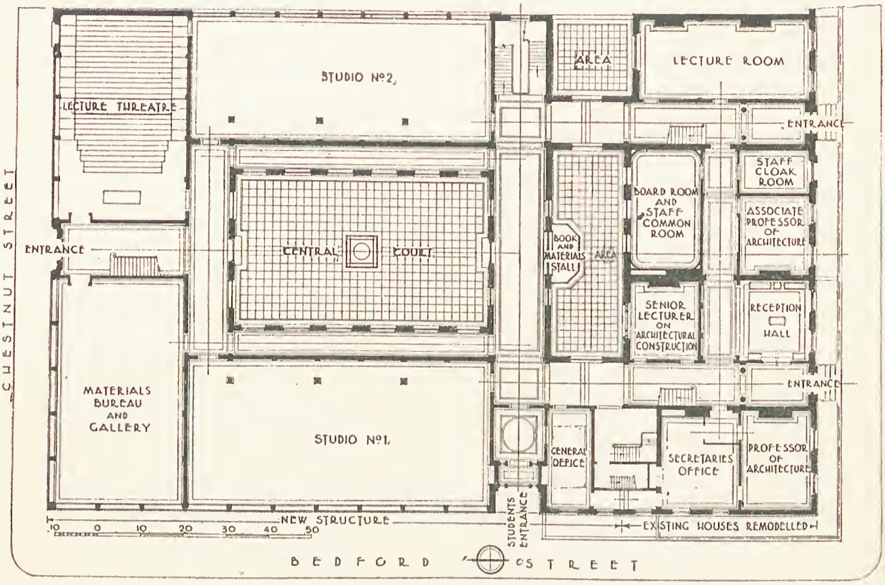


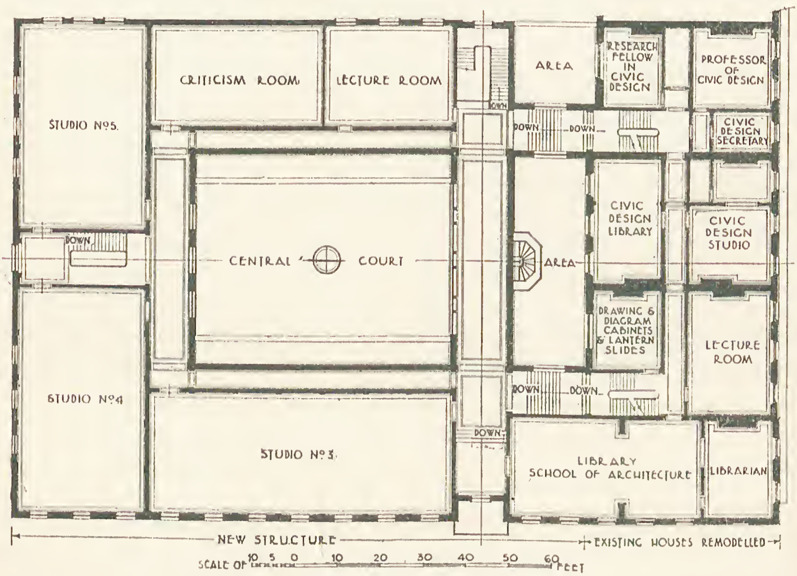
Fig. 1.—LIVERPOOL SCHOOL OF ARCHITECTURE : CENTRAL COURT

View of the courtyard within the school. The plans are given in Fig. 2. (*Architects : C. H. Reilly, L. B. Budden, and J. E. Marshall, FF.R.I.B.A.*)

IN common with many other branches of architectural practice, the design of school buildings has made considerable progress during the last few years, and the most recent examples possess very few of the characteristics of pre-war school buildings. New materials and methods of construction have brought about many changes, and the re-housing of the population, which has been carried out more systematically than hitherto, not only provides a demand for more and better



GROUND FLOOR PLAN



FIRST FLOOR PLAN

Fig. 2.—LIVERPOOL SCHOOL OF ARCHITECTURE

These plans show the close planning usually necessary when schools are erected on valuable sites. The view of the courtyard illustrates the architectural value of carefully designed internal courts and the provision of clerestory lighting to the ground-floor studios. (*Architects : C. H. Reilly, L. B. Budden and J. E. Marshall, FF.R.I.B.A.*)

schools, but has also made it possible to provide adequate sites for such buildings.

The increasing importance of higher education and instruction in technical subjects has created a demand for buildings of special types, and this demand, coupled with the need for the re-modelling of existing buildings of an unsatisfactory type, is envisaged in the national policy of re-building, which will involve several hundreds of schools.

Most school buildings are, to some extent, controlled by the Board of Education, whose memoranda on the various aspects of school planning must be studied by all architects responsible for this type of work. These publications provide a considerable amount of data and indicate the minimum basic requirements, but it will be found that they do not, in any respect, represent an undesirable limitation to the imaginative planning and construction of new buildings.

The Site

The architect is frequently called upon to advise regarding the suitability of a site for a school building, but the first decision must, of course, rest with the education authorities, with special reference to existing or future traffic routes, and to the probable development of the locality in question. It will be at once obvious that the shape and slope of a site will determine its suitability, while a large and expensive site will sometimes permit a more efficient and cheaper building than is possible on a small and difficult site. It is highly desirable that the selection of the site should envisage the possible extensions to the building, and in most cases the provision of suitable playing space.

Generally speaking, the sites for modern schools will need to be considerably larger than those hitherto selected, owing to the tendency to provide fewer storeys. In fact, many authorities consider the ideal school to be a single-storey building, with the various wings widely placed so as to provide sunlight and fresh air to all rooms.

While the site should be reasonably open it should not be unduly exposed to prevailing winds, and precautions must be taken to avoid sites which are made up or which are in dangerous proximity to damp districts.

In schools for which playing fields are required, it is usually necessary to provide an area for this purpose of two to seven acres, according to the size of the school and the games to be played.

It is essential that a school should have quiet surroundings, but in the case of technical colleges, which are used chiefly in the evening, convenient access to transport facilities is probably of greater importance.

The usual supply services (gas, water, electricity) should be readily available, while the school building must be so placed on the site that access to the sewers can be obtained.

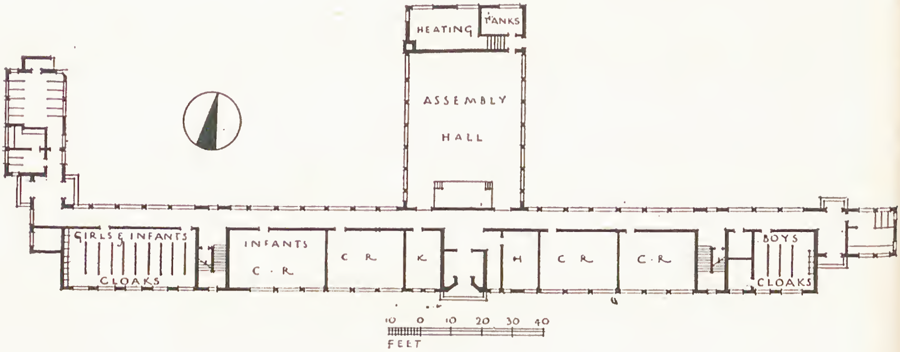


Fig. 3.—ELEMENTARY SCHOOL, ASHFORD

Ground-floor plan of a two-storey school for 388 mixed scholars. The structure is a reinforced concrete framework with brick cavity walls. (*W. T. Curtis, F.R.I.B.A., Middlesex County Architect.*)

Planning

While it is not the intention of this article to describe the many older and now out-of-date types of school, students are advised to review the various types of school planning which were more or less standardised in the past. These will, in most cases, exhibit obvious defects which are to be avoided, and such study will be most useful.

The two chief considerations in school planning are efficient circulation and the orientation or aspect of classrooms. It is generally agreed that a south-east aspect is best for classrooms, since such an arrangement ensures the maximum degree of beneficial sunlight during the early part of the day. In rooms for special purposes a different aspect is sometimes desirable, but in the case of technical colleges, which are frequently built on comparatively small sites, it is not always possible to provide the ideal aspect to all rooms owing to the need for close planning: however, since such schools are used mainly in the evening, this is not a serious disadvantage, and is of less importance than good circulation.

It will also be appreciated that in such cases it may be of the first importance so to place lecture and classrooms as to isolate them from noisy thoroughfares.

Circulation

Each type of school presents a different problem of planning in relation to circulation, but in every case it is of the first importance to provide the students' entrances, cloakrooms, and classrooms in a convenient sequence so as to avoid confusion of traffic. Where some of the classrooms are located on upper floors, the staircases should be placed near the entrances. Cloakrooms are usually situated on the ground floor, except in the case of multi-storey technical colleges having separate departments on each floor, when it may be desirable to have departmental cloakrooms.

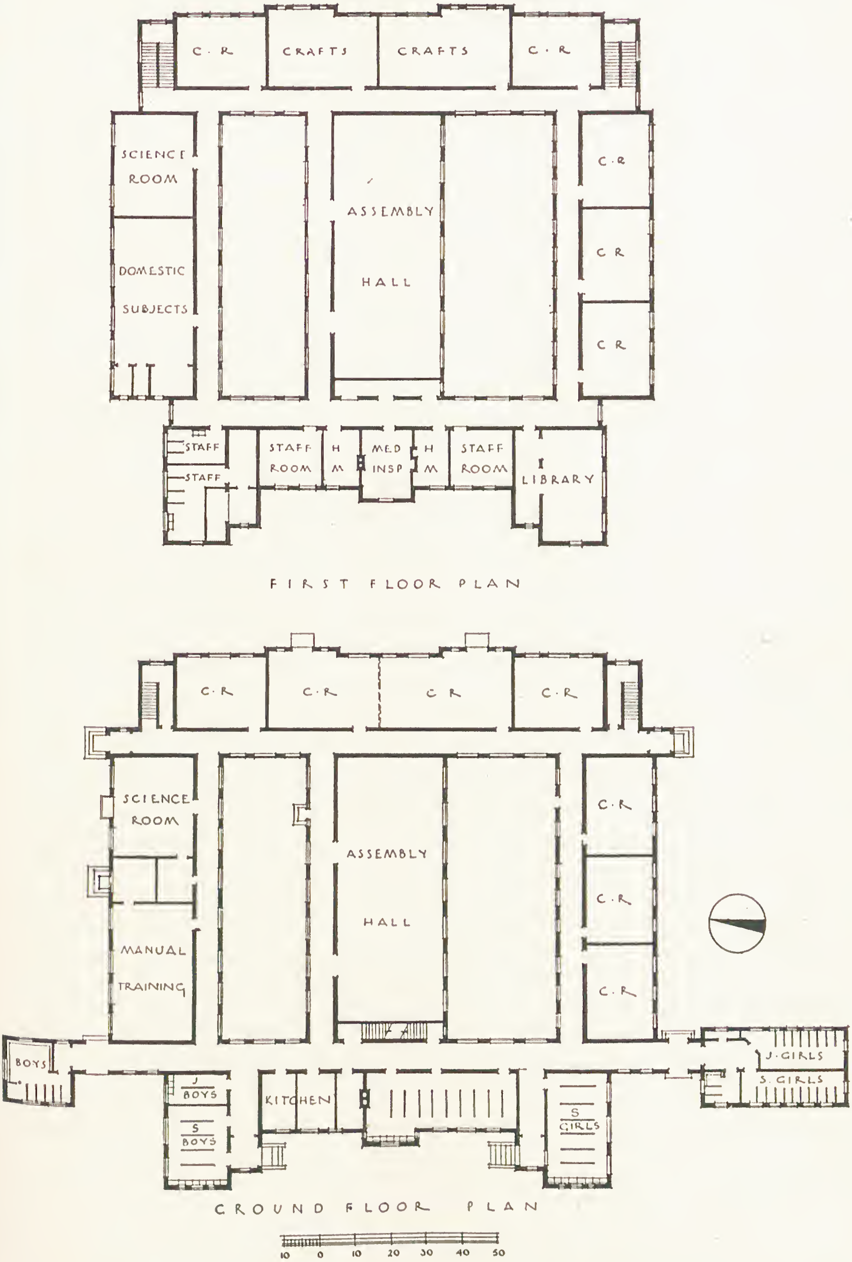


Fig. 4.—OAKWOOD SCHOOL, SOUTHGATE

This school provides accommodation for 400 seniors and 340 juniors on two floors. (*W. T. Curtis, F.R.I.B.A., Middlesex County Architect.*)

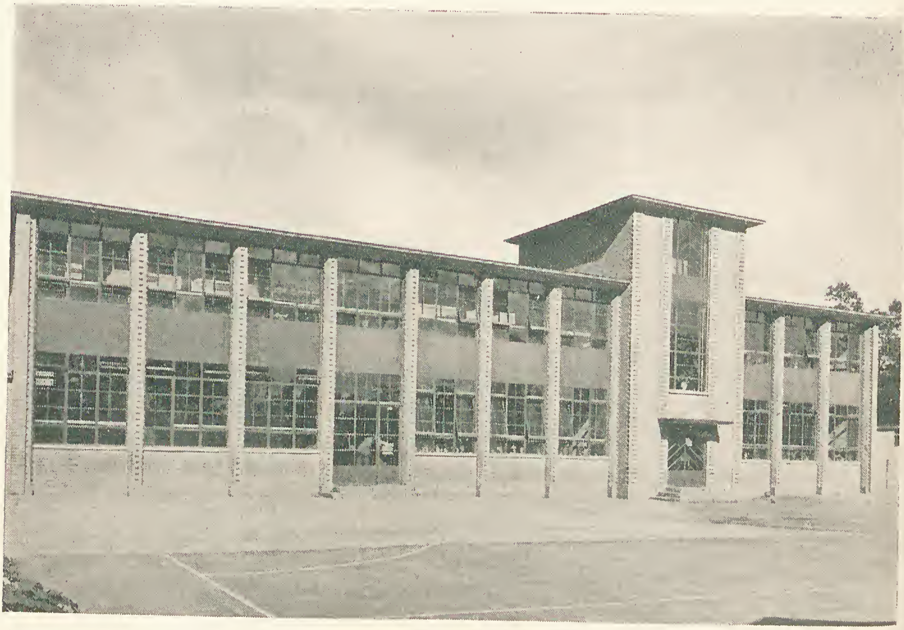


Fig. 5.—PINNER PARK COUNCIL SCHOOL, HEADSTONE

Front elevation, showing brick facing to a reinforced-concrete frame. (*W. T. Curtis, F.R.I.B.A., Middlesex County Architect.*)

Handicraft rooms and certain workshops in technical colleges should be provided as detached buildings, or placed some distance from classrooms, so as to minimise the transmission of sound and vibration: such an arrangement will also facilitate the delivery of materials from a suitably placed goods entrance without using main corridors.

The administrative and staff rooms may usually be placed near the main entrance, and at the same time be centrally situated so as to facilitate supervision.

Assembly halls should be readily accessible from all parts of the school without involving the confusion of traffic streams, while in large schools and technical colleges, rooms which may be common to all departments (dining-hall, library, etc.) should be placed as centrally as possible.

Lavatory accommodation should normally be concentrated in a central position for reasons of convenience and economy, but additional lavatories should be provided in conjunction with all workshops.

Technical colleges planned on more than one floor should have a goods lift suitably placed to serve the stores in all departments: in this connection it is of vital importance to provide adequate storage accommodation in all departments using large quantities of apparatus and materials.

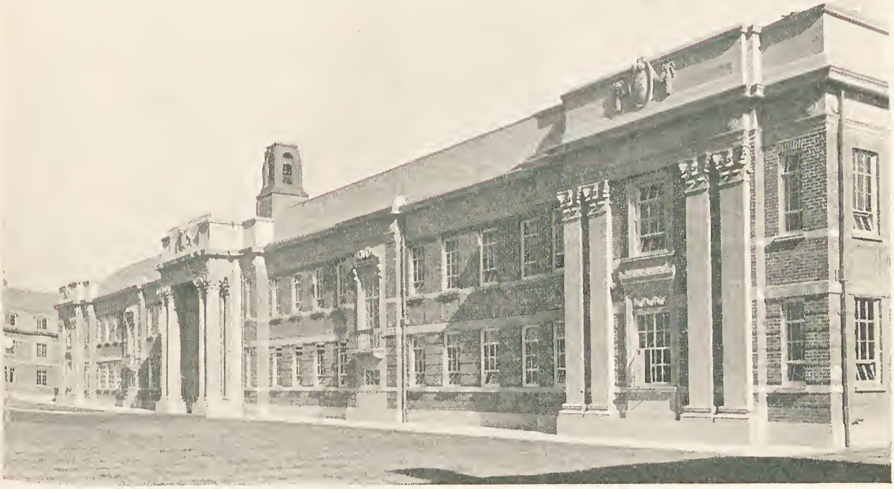


Fig. 6.—EDGE HILL TRAINING COLLEGE, ORMSKIRK

The educational block, as a central feature. (*Architect : Stephen Wilkinson, F.R.I.B.A., Lancashire County Architect.*)

Size of Bays

Once the general disposition of rooms is determined it is an advantage to plan the building on a " unit " basis, using as far as possible a standard structural unit or bay throughout. The size of bay will usually vary in each type of school with the dimensions of the normal classroom adopted. For example, the normal elementary-school classroom for forty children is about 25 ft. 6 in. long and 19 ft. wide : if such a room is constructed in three bays of 8 ft. 6 in. each, the structural unit will be 8 ft. 6 in. by 19 ft. Additional width may be required for science and housecraft rooms, etc., but these may be superimposed to form one wing or block. It will be readily appreciated that the use of flat roofs permits great freedom in the variation of width of the various parts of the building.

Aspect

In most elementary and secondary schools, rooms are usually placed only on one side of corridors, thus permitting good cross-ventilation across the corridor on the ground floor, and over the top of the corridor roof on the top floor. Although in some technical colleges it is necessary to plan rooms on both sides of corridors, such corridors must be well lighted and ventilated by the judicious placing of staircases or recesses at intervals in the length, and windows at the ends, of the corridors.

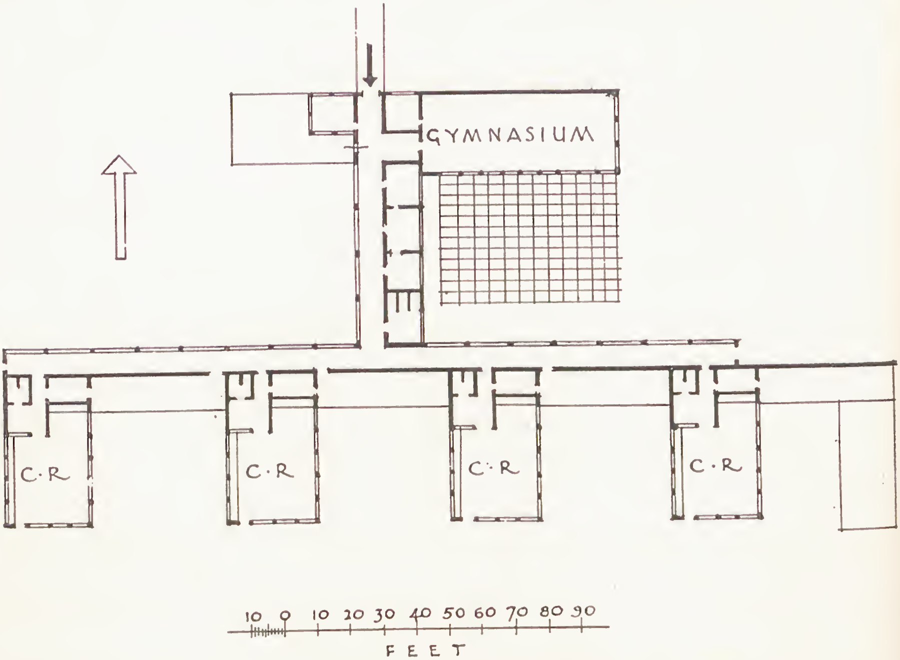


Fig. 7.—AN ELEMENTARY SCHOOL, BRUSSELS

A small school having four classrooms which can be converted into open-air pavilions: each classroom has separate cloak and lavatory accommodation.

Notwithstanding the sometimes elaborate requirements of circulation and aspect, it is desirable to plan school buildings in a simple and orderly manner, for reasons of both economy and effect.

Elementary-school buildings should be attractive to young children, while large and important schools and colleges may acquire even civic importance: the examples illustrated show that architectural interest may be achieved by skilful composition and the judicious use of modern material, rather than by imitating those historical styles which are traditionally associated with school buildings, but which so rarely permit the degree of natural lighting, ventilating, and economy which are essential features of modern school planning.

Assembly Hall

The assembly hall is usually the largest unit of accommodation in schools of all kinds. Besides normal purposes of assembly, the tendency is to use the hall for various functions connected with school life and parents' organisations, for which purpose it may be found most desirable to arrange for the hall to be immediately accessible for public use without interfering with the normal work of the school.

It is also desirable to envisage the use of the hall for dramatic performances, exhibitions, wireless talks, etc., and to arrange classrooms which may be used as dressing-room, etc.

For many years it was the custom in elementary and secondary schools to arrange some of the classrooms to open direct from the hall, but this had many obvious disadvantages, and should not be adopted in new schools. In all cases it is important that there should be some degree of isolation from those rooms where teaching is carried out, in order that the hall may be used for singing-lessons or drill without undue disturbance to the rest of the school.

Size of Assembly Hall

In elementary schools the assembly hall should have an area of not less than 1,800 sq. ft., but in large schools this area must be increased in order to provide adequate accommodation for all students. In secondary schools there should be an allowance of 6 sq. ft. per student, but if the hall is used as a dining-hall, an allowance of from 8 to 10 sq. ft. is necessary. In technical colleges, which are frequently educational and social centres for large areas, the assembly hall may assume much greater importance, and be required for use by the public in connection with the various social activities of the college. In these circumstances, it is necessary to arrange the seating accommodation to comply with the local regulations governing places licensed for public entertainment.

In all cases a stage or platform is desirable, and this should be not less than 30 ft. by 20 ft. in the case of elementary schools. In some cases, it is possible, by increasing the area and by judicious planning, to use the stage as a classroom, with sliding doors to be opened when the classroom is used as a stage.

The entrances must be planned so that students may leave the hall rapidly in case of emergency, while if the hall is being used for public entertainment, the arrangement and number of entrances and exits must comply with the regulations referred to above.

In view of the increasing use of films, it is important to provide a projection room and for the darkening of windows. If non-inflammable films are used, it is possible for the projector to be worked in the body of the hall, but such an arrangement is undesirable, and may limit the scope of this kind of instruction.

If the hall is used as a dining-hall, it is desirable that it should be planned conveniently near to a kitchen and the usual services. It will be an additional advantage to arrange the rooms used for the teaching of domestic science reasonably near to the hall.

The space under the platform may be used for the storage of chairs.

Assembly halls must be well lighted, and since mechanical ventilation is usually unsuitable except in very large halls, it is desirable to arrange for natural ventilation by means of windows on each side of the hall.

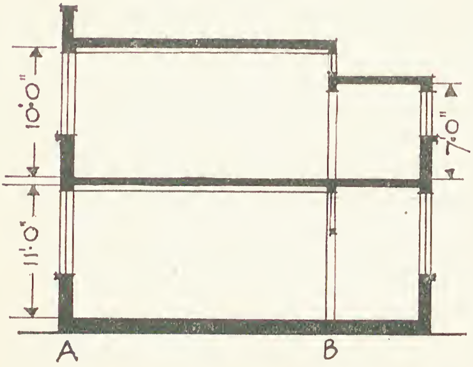


Fig. 8.—DIAGRAMMATIC SECTION SHOWING CEILING HEIGHT SUITABLE FOR ELEMENTARY AND SECONDARY SCHOOLS

By placing the stancheons at points A and B, and constructing the external wall of the corridor independently, it is possible to obtain cross-ventilation to the first-floor classroom over the roof of the corridor.

Careful consideration must be given to the acoustical properties of the hall. This should be made the subject of special study in each case, but in general it may be observed that excessive height is undesirable, curved ceilings usually create serious difficulties, and that hard-plastered walls should be avoided.

Where the platform is used for orchestral and theatrical performances, some form of proscenium should be provided, together with facilities for erecting scenery. Special attention should be given to stage lighting, and to the planning of retiring- and dressing-rooms, with lavatory accommodation.

Exhibition Hall

Most large technical colleges on the Continent now make a special feature of an exhibition hall, where examples of work executed by students may be displayed for the benefit of students and the public. Such an arrangement offers great advantages, and may well be considered in connection with the design of similar institutions in this country.

Dining-hall

The use of the assembly hall for the serving of meals has already been referred to, but this is an arrangement which should be adopted only where rigid economy is essential, or where the assembly hall is used only occasionally for school assemblies. In large technical colleges, it will usually be found that the number of persons attending the evening school will far outnumber those in full-time attendance, and it is therefore essential to anticipate the extent to which the dining-hall will be used. A floor space of from 8 to 10 sq. ft. per person is desirable if meals are served at tables, but larger numbers may be accommodated if food is served from a buffet, in which case the tables may be much smaller.

Classrooms

The size and equipment of classrooms are determined by the number and type of students, and it is important to bear this in mind when designing a school which may be used as an evening school for adults.

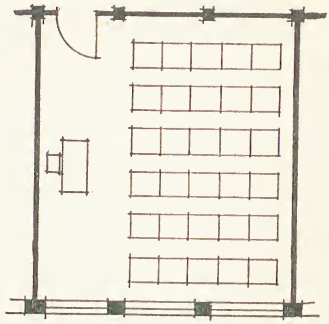


Fig. 9.—PLAN SHOWING ARRANGEMENT OF SEATING IN A TYPICAL SECONDARY SCHOOL CLASSROOM FOR 30 STUDENTS WITH SINGLE DESKS

In elementary schools, an area of from 480 sq. ft. to 520 sq. ft. is considered desirable for a class of forty children. In secondary and technical schools, the area should be equivalent to 16 ft. super per place, with an increase up to 20 ft. in schools where adults may have to be accommodated in the evening. The width of a classroom is usually from 20 ft. to 24 ft., but this must be determined in relation to the height of the windows in order that adequate natural lighting may be provided. A height of 11 ft. is now usual in the case of ground-floor classrooms of about 20 ft. in width, while in upper-floor classrooms, which are cross-ventilated, a height of 10 ft. is permitted. In the case of classrooms having a pitched roof with ceiling at collar-beam level, the height should be 10 ft. to the wall plate, and 13 ft. to the collar beam.

In a room 11 ft. high, no desk should be more than 20 ft. from the source of light. The length of a classroom for ordinary purposes in elementary and secondary schools should not be more than 25 ft., a distance which ensures good visibility of the blackboard. In technical schools, however, where classes may be large, this distance is frequently increased to 35 ft.

The chief source of natural lighting must be from the left-hand side of the room facing the blackboard, and windows should be as large as possible, the glass area equalling at least one-fifth of the floor area. Generally speaking, cill levels should be 3 ft. 6 in. high, although in some cases it is the custom for windows to extend to the floor level, particularly in the case of infant schools, where French windows may give access to a veranda used for open-air classes. Windows should not be placed in the wall behind the teacher or behind the scholars, but they are frequently provided on the upper part of the right-hand wall, in order to provide cross-ventilation. This may be achieved very readily in single-storey buildings, but in buildings of more than one storey, it is necessary to provide cross-ventilation from a corridor by means of opening, borrowed lights.

It is usually necessary to provide a space about 7 ft. 6 in. from the blackboard to the front row of desks, and the door from the corridor should open into this space, thus making it possible to plan desks or other seating accommodation economically.

As previously stated, the size of seating varies with the number and age of students. Single or dual desks may be used, with widths of 18 in. to 20 in. for the former, and at least 4 ft. for the latter, while a depth of at

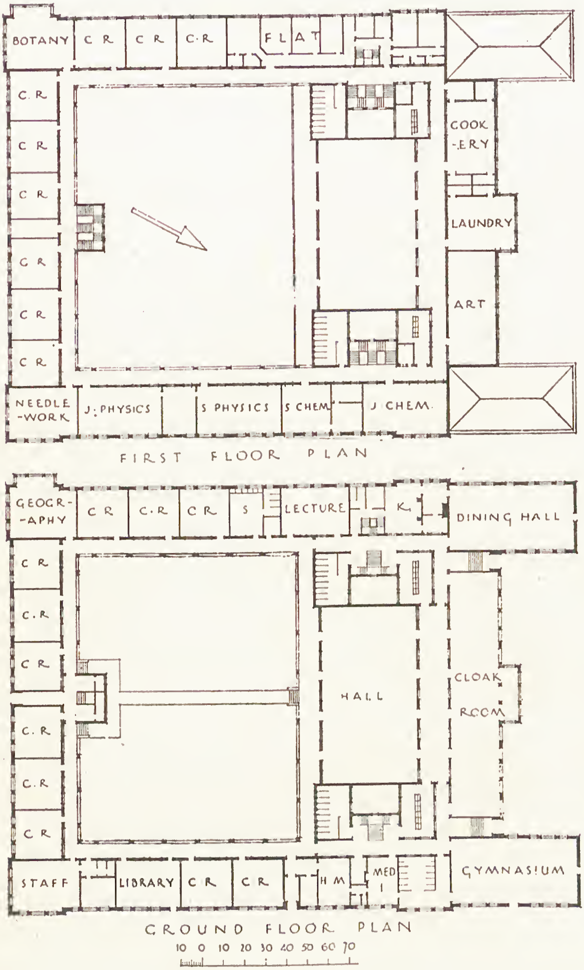


Fig. 10.—THE BOLLING HIGH SCHOOL FOR GIRLS, BRADFORD

This school has well-arranged accommodation for all of the subjects usually taught in such schools, including a complete flat for the teaching of housewifery. The lavatories and cloak-rooms are arranged in four groups, to avoid congestion. (*W. Williamson, City Architect.*)

least 2 ft. 5 in. should be allowed for each desk. There should be 18 in. between the side desk and wall, 16 in. between desks, and 12 in. between the back row of desks and the back wall: these dimensions are satisfactory in elementary schools, but should be increased in secondary schools. Tables and chairs are sometimes used, but these require considerably more floor space than desks.

Drawing-offices

In technical colleges it is necessary to provide rooms which are specially equipped for drawing. These rooms will be similar in many respects to class-rooms, but they must always be planned with due regard to the type of furniture to be installed. Flat-topped tables and stools are usually found preferable, and these must be designed in relation to the size of drawing-board which is to be used. Besides the usual equipment, it is important to provide adequate storage space for drawing-boards, T-squares, and students' work. Drawing-offices should have north light, and may be up to 26 ft. wide.

Lecture Theatres

Fig. 11.—HARTLEY BROOK SCHOOL: JUNIOR DEPARTMENT QUADRANGLE. (*W. G. Davies, F.R.I.B.A., City Architect, Sheffield*)

Lecture theatres are usually provided where it is necessary for students to observe demonstrations, and it is therefore essential that good visibility and audibility should be achieved. In every case it is desirable to provide raised seating in tiers, a rise of 6 to 8 in. for each row usually producing satisfactory results. An allowance of 2 ft. run of desk per student is necessary, and in order to achieve this a superficial area of about 12 ft. of floor space per person is required. The room should be adequately lighted and, in addition, special provision must be made for darkening the room. A generous allowance of demonstration table for the lecturer is necessary, the fitting up of which must be considered carefully in relation to the subject taught. In addition, it is usually desirable to provide a small preparation room adjoining or near to the theatre.

Handicraft Rooms and Workshops

These may range from the simple requirements of elementary schools to those of large technical colleges, where the teaching may include practical instruction in the building crafts, cabinetmaking, the various branches of engineering, leather, rubber, and textiles technology, and printing.

In elementary schools, the instruction is usually limited to woodwork and metalwork, provision for which may be made separately in two rooms

Fig. 12.—Hartley Brook School: junior department, south elevation
(*W. G. Davies, F.R.I.B.A., City Architect, Sheffield*)

of about 850 ft. super each, or in one room of about 1,500 ft. super. The smaller rooms will each accommodate twenty students, and the larger one forty. In addition, there must be ample storage space of about 250 ft. super, two-thirds of which might be partitioned off as the timber store, and provided with direct access from the school yard or playground. The equipment should consist normally of benches, each for two students, usually of varying heights so as to accommodate boys of differing sizes.

It is an advantage to provide a separate tool-rack for each boy, racks for special tools, cupboards, grind-stone, and a bench for glue-pots. A small amount of power-driven machinery is sometimes provided in metalwork rooms, such as a lathe, drilling machine, and grinder, while in some cases a power-driven circular saw may be provided in the woodwork room. This machine will effect a considerable saving in the instructor's time, but it is highly dangerous, and besides being adequately guarded should be located in the workshop with due regard to safety.

It is essential that the whole of the furniture and equipment be carefully planned to provide easy access to each bench, and with special reference to the position of heating radiators and windows. Good lighting is essential, and if the room is planned as a separate wing it will be possible to provide windows on each side.

The handicraft rooms should be so located as to avoid undue disturbance of the rest of the school by the noise which is inevitably associated with handicrafts.

In secondary schools, the accommodation is sometimes a little more elaborate, but the foregoing observations will apply.

Fig. 13.—STURRY HERSDEN CENTRAL SCHOOL
(*Architect: W. H. Robinson, F.R.I.B.A., County Architect, Kent*)

The school provides accommodation for approximately 240 pupils (mixed), and is planned for an ultimate extension of approximately double this number. The area of the site on which the school is placed is approximately 10 acres.

The building is of a special plan and construction, the whole of which is of single storey, based on an "H"-shaped plan with the hall in the centre. This, in addition to being used for assembly purposes, is used as a dining hall, and is served from a large top-lighted kitchen block adjoining. The art room is placed at one end of the hall and divided therefrom by a sliding partition, so that the seating space can be considerably increased if required for performances, etc. The classrooms are planned on the south side of the buildings, whilst the practical workroom block is planned on the north side. Both of these are approached under cover, by means of glass-roofed verandahs.

The construction consists of steel framing, with stuccoed brickwork on the outside, and faced concrete block wall filling on the inside (thus forming a hollow wall). The large windows of both sides of the classrooms are made to slide, in order to achieve the maximum lighting and cross ventilation. The roofs throughout are flat and are formed of timber, the framing of which is arranged to ventilate at eaves, in order to prevent the penetration of heat in the summer.

The whole of the buildings are heated by low-pressure hot-water systems, operated from two semi-basements. The artificial lighting is by gas, switch-controlled (electricity not being available at the time).

In technical colleges, it is usually essential to envisage instruction on lines comparable with those practised in the industries concerned. The architect must always make himself familiar with the requirements of the various trades concerned, and plan his workshop accommodation accordingly. Generally speaking, workshops must consist of well-lighted and well-ventilated rooms, as free as possible from columns or other obstructions. In large workshops, top lighting is essential.

Fig. 14.—Technical College, Blackpool
(*Architect : J. C. Robinson, F.R.I.B.A.*)

The workshops generally should be grouped together, away from the blocks containing classrooms, and special attention should be given to access from the yard or playground for the delivery of materials and the collection of rubbish, which accumulates in many trades, such as bricklaying. Adequate storage accommodation is always essential, both for materials and for student's work.

Notwithstanding the provision of adequate lavatory accommodation elsewhere, it is very desirable to provide accommodation for washing in conjunction with workshops.

PLANNING AND DESIGN OF SCHOOLS

PART II.—SCIENCE, ART, AND OTHER ROOMS, GYMNASIUM, ETC.

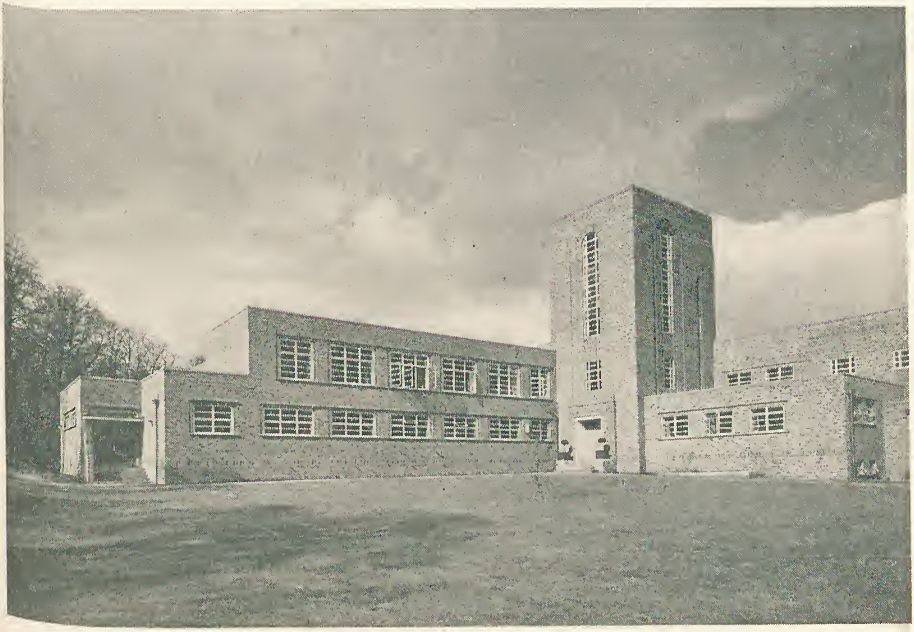


Fig. 1.—MILL HILL SECONDARY SCHOOL FOR GIRLS

Planned for total accommodation of about 480 scholars. Plans are given in Figs. 2 and 3. (*Architects : W. T. Curtis, F.R.I.B.A., and H. W. Burchett, A.R.I.B.A.*)

IN elementary schools, rooms devoted to domestic science are usually referred to as housecraft rooms, and the subjects consist usually of cookery and laundry work. It is desirable to provide separate rooms of at least 800 ft. super for each subject, each room accommodating twenty students. In addition, there should be ample storage accommodation, and a larder which must face north.

The cookery room should be provided with three or four ovens which might, with advantage, be of different types, namely, a coal range, gas

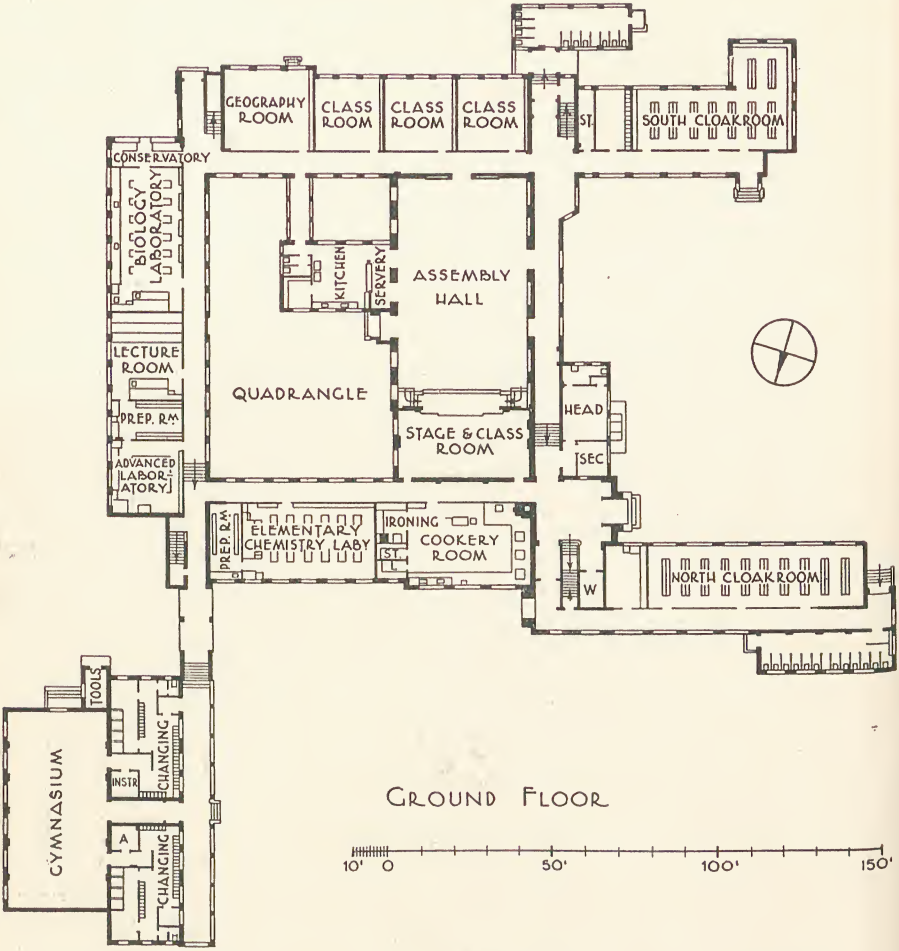


Fig. 2.—GROUND-FLOOR PLAN OF MILL HILL SECONDARY SCHOOL FOR GIRLS

cookers, and electric cookers. A domestic boiler should also be installed, and used in connection with the hot-water supply to kitchen sinks and to the laundry, the laundry equipment consisting of washing-sinks or tubs, wringer, and ironing-tables ; these must be planned so as to provide for the proper sequence of operations, and in order that the teacher may readily supervise the work of each student.

The planning of the equipment must be considered at an early stage in order that adequate drainage may be provided.

The accommodation in secondary schools is very similar, but in colleges specialising in training for women, much more elaborate accommodation is usually required, and may include all or some of the following : needle-

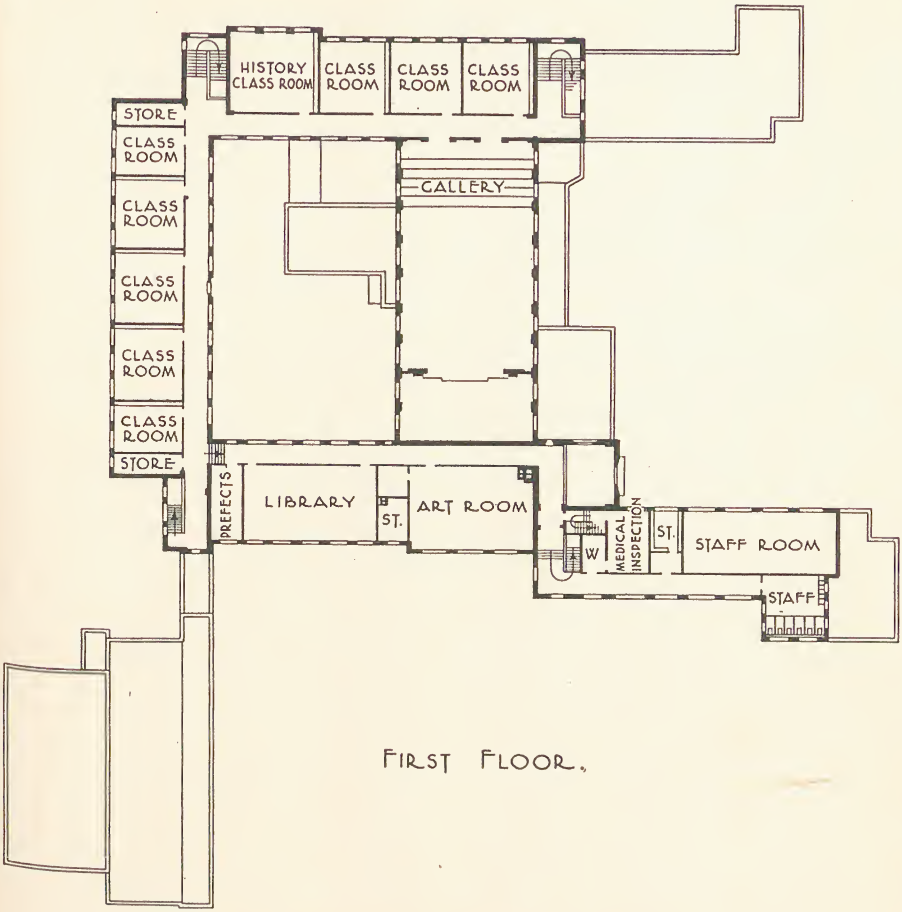


Fig. 3.—FIRST-FLOOR PLAN OF MILL HILL SECONDARY SCHOOL FOR GIRLS

work and dressmaking rooms ; fitting-room ; cookery rooms equipped for various branches of the work ; a cookery demonstration room ; a housecraft room which might, with advantage, be planned as a model flat ; laundry ; upholstery room ; and in some cases, rooms suitably equipped for home arts and crafts. The area of accommodation required in each case must depend upon the nature of equipment to be provided. It will be found that this area will range from 30 to 50 sq. ft. per student. The working tables or benches should be arranged to face a teacher's desk, or in the form of a hollow square, the students working on the outside, and each, therefore, being under the immediate supervision of the teacher, whose demonstration table is in the centre of the square.

North light is usually desirable in all cookery rooms, but elsewhere a

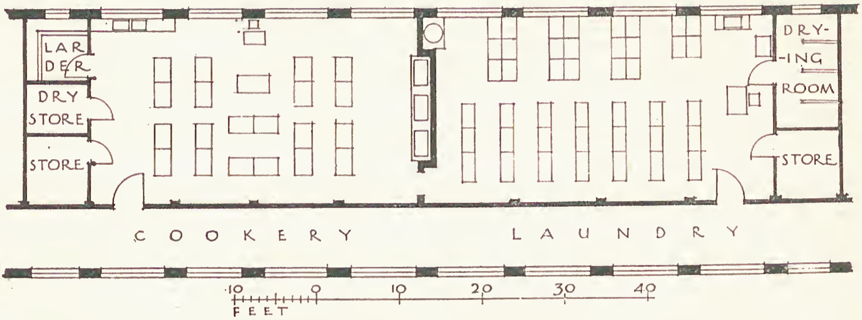


Fig. 4.—House-craft rooms

Cookery room with tables for 20 students each facing the teacher's demonstration table. Laundry with ironing tables and sinks for 20 students: the sinks are placed against the external wall to facilitate drainage.

bright, sunny aspect is an advantage. The artificial lighting must be carefully planned in relation to the working places. For dressmaking and work of a similar nature, it is an advantage to provide a separate light for each student.

Science Rooms

The rooms required for the teaching of science will vary from the simple science room in an elementary school, to a complete and elaborately equipped set of laboratories for the teaching of chemistry, physics, pharmacy, biology, etc., in large technical colleges.

It is essential that no attempt should be made to plan even the simplest room without considering very carefully the benches and equipment to be installed. Although few existing elementary schools are provided with science rooms, it is probable that they will be required in all future schools of a senior grade. In such cases, the science room should be at least 900 ft. super for a class of forty, with an adjoining preparation room and store of about 200 ft. super. If these rooms are combined, an area of about 1,000 ft. super may suffice, but such an arrangement is not so satisfactory. The science room may be used for a variety of purposes, and should be well lighted, preferably from the south. The equipment is usually very simple, and plain but substantial tables with drawers are required. Tables 5 ft. long and 3 ft. 6 in. wide will accommodate four students, two on each side. The teacher's demonstration bench should have a sink, and gas and electricity points. Ample cupboard accommodation is essential, and it is an advantage to provide side benches; the side walls should have rows of battens upon which models may be fixed. One or two additional sinks and gas and electricity points may be suitably arranged on a wall bench underneath the window. If the school is to be used by adults in an evening school, the equipment may require to be more elaborate. Good side lighting is essential, and the artificial

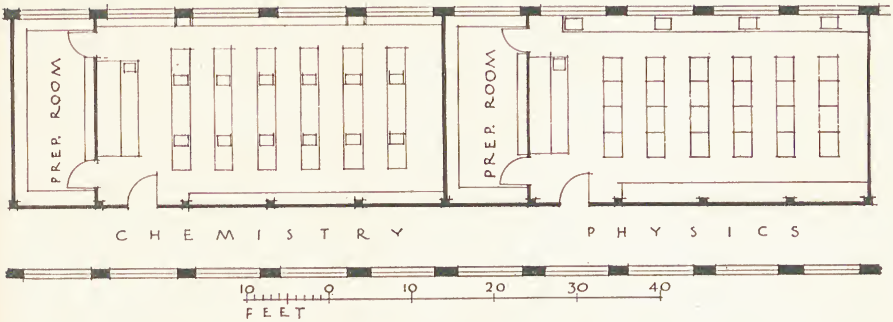


Fig. 5.—SCIENCE ROOMS

Each laboratory is arranged to accommodate 24 students, with side-benches for special apparatus and a raised demonstration table for the teacher.

lighting must be planned in relation to the working benches, especially if the school is used in the evening.

In secondary schools, separate laboratories for chemistry and physics are necessary, and an allowance of about 30 sq. ft. per student is required. In some cases, benches are about 2 ft. 3 in. to 2 ft. 6 in. wide, for students working on one side only, with one sink for each two students. Such an arrangement possesses obvious advantages, but it is more economical to provide benches from 4 ft. to 4 ft. 6 in. wide, with students working on both sides. There should always be a demonstration table fully equipped with sink, water, gas, and electricity.

If a laboratory is to be used also for the teaching of botany, a south aspect is essential, and one of the windows should be fitted with a cabinet for growing plants.

It is not possible to describe in detail the various rooms which may be required in a large science department: these will include lecture theatres for each section, each having an adjoining preparation room and store. Laboratories may be required for general, organic, and physical chemistry, general physics, and biology, with the possible addition of specially equipped rooms for pharmacy, and for the teaching of science applied to particular industries. Balance rooms should be provided adjoining each laboratory requiring the use of balances. A large departmental store-room is desirable, and this should be provided with a serving hatchway in order that chemicals and apparatus may be issued to students.

Various opinions have been expressed with regard to the best location for a science department. If the laboratories are on the top floor, ventilation, which must always be adequate, is more easily arranged, but the problem of drainage, which is very considerable, is obviously much more difficult than if the laboratories are placed on the ground floor. The choice of these two alternatives is usually determined by the nature of the site and general disposition of other accommodation. If

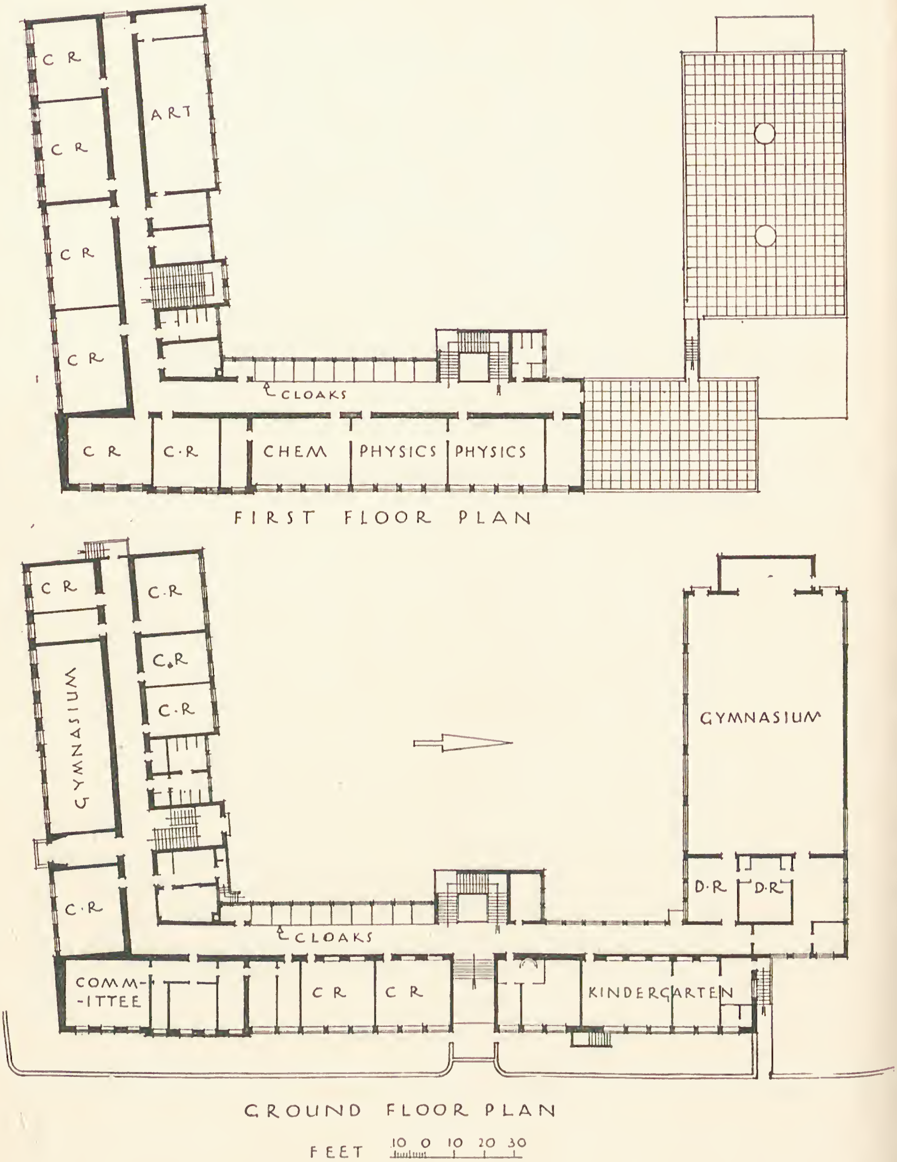


Fig. 6.—SECONDARY SCHOOL FOR GIRLS, VIENNA

A three-storey building of reinforced concrete. Cloakrooms are provided on each floor, with one compartment for each class.

the site is a large one, and the building limited in height, it will usually be possible to place laboratories in a separate wing, but if a technical college

is built on a restricted town site and a multi-storey building is necessary, then it is usually desirable to place the science department on the top floor. The chief features to be considered in the planning of laboratories are : efficient drainage, which must be accessible for cleaning and repair ; the adequate ventilation of the room and the fume cupboards ; the natural and artificial lighting of all working space ; the accessibility of the balance room and stores, and the arrangement of benches for special processes.

Art Rooms

An art room for forty students should have an area of at least 900 ft. super. A square room is preferable, and a north light must be provided by one large window or a centrally placed group of windows not less than 12 ft. high.

Other windows are useful to admit sunlight, but they should be capable of being screened by curtains or blinds.

The equipment usually consists of light stools, with one or two tables for special work. Ample storage space is essential, and one or two sinks should be provided.

Medical Inspection Room

A room is provided in most schools for medical inspection. This should be not less than 20 ft. long, in order that eye-testing may be carried out, and a width of 12 ft. or 13 ft. is desirable.

It should be provided with a sink, and some form of auxiliary heating, such as a gas fire or electric fire, is an advantage.

Corridors

The width of corridors must be determined by the amount of traffic, but they should never be less than 7 ft. wide. In elementary and secondary schools it is customary for corridors to have rooms on one side only, with windows on the other side. In such cases a considerable length is not a disadvantage, but in technical colleges, and other buildings where rooms may be placed on each side of the corridor, long, unlighted corridors must be avoided.

If the corridor is to contain built-in show-cases and storage cupboards, additional width must be provided.

Staircases

Staircases must be placed reasonably near entrances, and should also provide alternative means of escape from all parts of the building in case of fire.

A width of 4 ft. may be regarded as a minimum, but staircases more than 6 ft. wide should have a handrail in the centre.

Steps must be well proportioned to provide easy going, and winding steps are to be avoided.

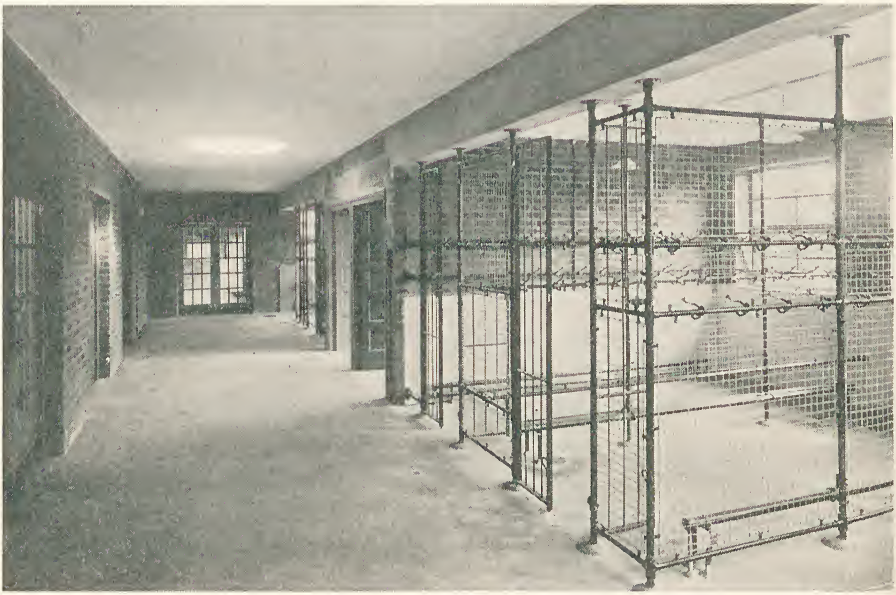


Fig. 7.—A CLOAKROOM NEAR ONE OF THE MAIN ENTRANCES, ROWLEY REGIS SENIOR BOYS' SCHOOL

An economical arrangement which ensures good lighting and ventilation, and facilitates supervision. (*Architects : Pritchard Godwin & Clist, FF.R.I.B.A.*)

Where the staircase leads to a corridor, the top step should be set back a few feet in order to provide a suitable landing without causing obstruction in the corridor.

Cloakrooms

In most modern schools, the cloakroom accommodation is planned on more generous lines than hitherto. In many existing schools the cloakroom is the scene of considerable congestion, owing to inadequate entrances and gangways, and the tendency is not only to increase the space allotted to each student but also to increase the width of gangways. In large schools the accommodation is best provided in a number of small cloakrooms instead of one large one. Pegs for hats should be arranged in one horizontal row, with a spacing of 10 in. for boys and 12 in. for girls, with gangways not less than 5 ft. wide between racks and at the ends of racks.

As has previously been pointed out, the cloakroom accommodation must be planned very carefully in relation to the entrances, staircases, and classrooms, and so located as to avoid congestion of traffic.

Separate cloakrooms are necessary for each sex in mixed schools, and for senior and junior students where they are accommodated in the same school.

Fig. 8.—TWO VIEWS OF DARTFORD EAST BOYS' CENTRAL SCHOOL

The school, which provides accommodation for 440 senior boys, is quadrangular in form. There are six classrooms of the normal type, a geography room, a science lecture room, a science room, an art room, a woodwork room, a metalwork room, and a hall. In addition there are the usual administration rooms, offices, cloakrooms, etc. There is a fully equipped canteen. (*Architect : W. H. Robinson, F.R.I.B.A., County Architect, Kent.*)

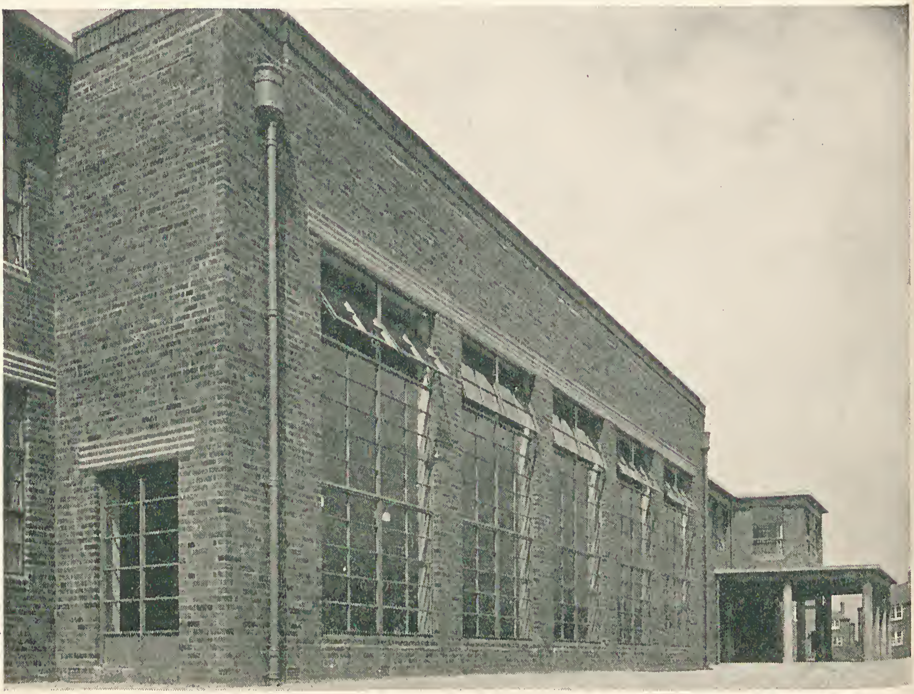


Fig. 9.—THE EXTERIOR OF THE GYMNASIUM, ROWLEY REGIS SENIOR BOYS' SCHOOL
(*Architects : Pritchard Godwin & Clist, FF.R.I.B.A.*)

They should be amply heated, and if heating pipes are placed against walls near the floor, it is essential to avoid close contact with boot racks or cages.

Many authorities are inclined to favour the provision of lockers in or near to classrooms, and a number of Continental schools have hat and coat lockers arranged in the thickness of a double partition between the classroom and corridor. Such an arrangement possesses obvious advantages in schools which are used in the evening by large numbers of students, by obviating the need for supervision of cloakrooms which would have to be kept open for the whole evening. In the case of lockers, an allowance of 12 in. each is usually desirable.

Although the heating of cloakrooms usually provides for the reasonable drying of clothes, it is sometimes desirable to provide special drying rooms, which may be most conveniently planned in conjunction with the cloakroom.

Lavatories

Lavatory accommodation must be provided for each sex, and for each section of a school providing for juniors and seniors. They should

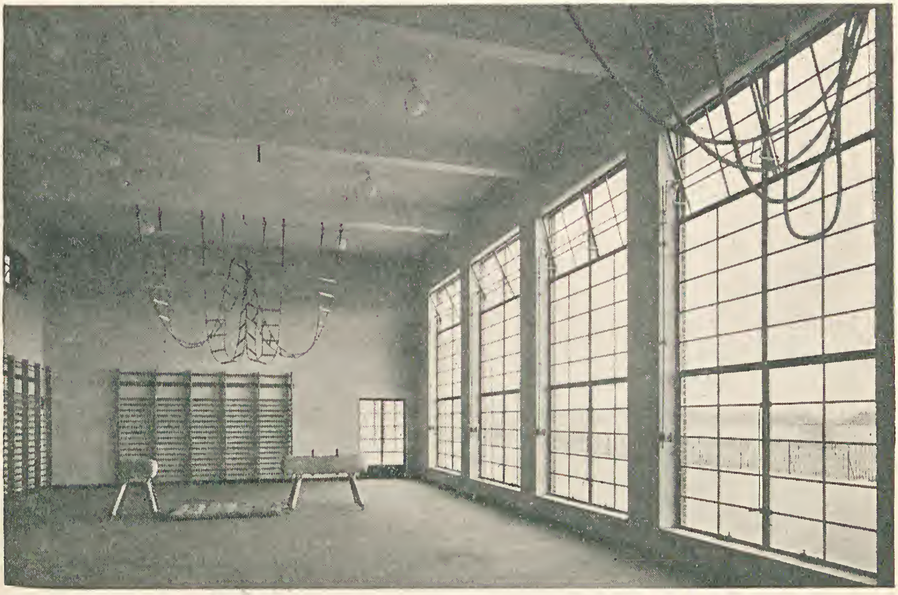


Fig. 10.—THE INTERIOR OF THE GYMNASIUM, ROWLEY REGIS SENIOR BOYS' SCHOOL (*Architects : Pritchard Godwin & Clist, FF.R.I.B.A.*)

be separated from the main building by means of a well-ventilated or open corridor, and be equally accessible from the school and playground.

W.C.s are usually required in the following proportion :—

Boys.—Four for the first 100, and three for each succeeding 100.

Girls.—Six for the first 100, and four for each succeeding 100.

The w.c.s should be from 2 ft. 3 in. to 3 ft. wide, with partitions carried up to a height of about 6 ft., and a space of about 6 in. at the bottom and top of the door.

Urinals should be provided at the rate of six for each 100 boys, but if in a straight run without divisions, there should be at least 10 ft. run for each 100 boys.

There should be a minimum of twelve washing basins for the first 100 pupils, and an additional four for each succeeding 100. The height of lavatory basins should vary according to the type of school, and where young children are accommodated it will be an advantage to arrange them in heights of 15 in. upwards.

Gymnasium

Although in the case of very small schools it may be necessary to use the assembly hall for physical training, such an arrangement is undesirable, and should not be encouraged in large institutions. A modern gymnasium should be at least 60 ft. by 30 ft., with large windows on both

Fig. 11.—A LIBRARY WING EXTENSION TO THE ABBOTSHOLME SCHOOL, ROCESTER, STAFFS

A corner of the older building is shown. The new library wing was designed in keeping with this. The building is faced with Jacobean bricks, and the stone used is from the Hollington quarries nearby. (*Architects : Oakley & Sanville, A. & F.R.I.B.A.*)

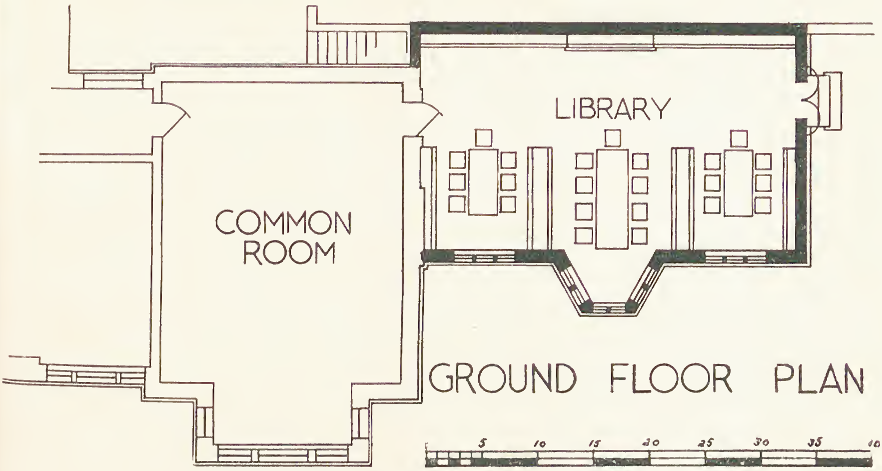


Fig. 12.—ABBOTSHOLME SCHOOL, ROCESTER. LIBRARY EXTENSION

The library is divided into three bays, so that a group of boys may be able to study in each bay.

sides to provide adequate light and ventilation. Generally speaking, the cill level should be about 3 ft. from the floor, but in schools used chiefly in the day-time, it is an advantage to arrange for the windows on one side to extend down to the floor, and to be capable of being opened out on to a paved terrace which may be used for outdoor work. The gymnasium should be not less than 16 ft. high, with a flat ceiling, which should be suitably constructed for the fixing of apparatus. The floor should preferably be constructed with narrow, secret-nailed tongued and grooved boards running across the room, supported on joists. In conjunction with the gymnasium, there should be an instructor's room and dressing-rooms, showers and lavatory accommodation, all of which might, with advantage, be duplicated in order that the gymnasium may be in continuous use. The gymnasium, with dressing-rooms, etc., is frequently planned as a detached group.

Many gymnasia have a small gallery at one end for the accommodation of spectators. This gallery, when provided, may be planned over the dressing-rooms, etc., and the seating stepped so as to provide spectators with a reasonable view of the floor.

Library

A library is not found in many existing elementary schools, and even in secondary schools it is usually quite a small room. The tendency is, however, to provide a library in all schools. In technical colleges the library is a most important feature. The accommodation may be provided as a central library, or as a series of small libraries in each department. The decision as to the most advantageous arrangement must

depend upon the planning and organisation of the rest of the building, but it is probable that in all except very large colleges, the central library provides the better arrangement, since it is then possible to engage a librarian.

The accommodation must provide adequate storage space for books and facilities for study. This is usually achieved by the placing of bookcases around the walls or in bays, with a free space in the centre for reading tables and magazine racks. Where possible, it is an additional advantage to provide one or two study rooms adjoining the library, and the accommodation should also include a room for the librarian, and adequate storage accommodation for bound copies of periodicals and books not in frequent use.

Students' Common Room

Common rooms are not usually necessary in elementary schools, where the children do not remain on the school premises outside the school hours. In secondary schools, however, it is usually desirable to provide at least one common room, for the use of children during break periods when it is not possible to use the playground. In technical colleges, which provide for large numbers of full-time and evening students, ample common-room accommodation is necessary in view of the increasing importance attached to social intercourse amongst students. The size and character of these rooms must be determined by the nature of the college ; they should include at least one large common room for all students, and a small retiring-room for women students.

Staff Rooms and Common Rooms

The accommodation for the teaching staff will depend upon the number engaged and upon the nature of the school. In elementary and secondary schools which provide education for boys or girls separately, one staff room will usually suffice, but in large colleges providing instruction for both sexes, and having a number of more or less self-contained departments, it is an advantage to provide separate staff rooms within each department, together with a separate room for each head of department. In addition, it is desirable to provide a large common room, where members of the staffs of the various departments may have an opportunity of meeting. In large colleges, the non-teaching staff will include laboratory assistants, porters, and cleaners, for whom accommodation must be provided. This should consist of a small common room for each sex, together with cloakroom and lavatory accommodation.

Administration Offices

The nature of these rooms will vary considerably, according to the size and organisation of the school. The accommodation may include a selection of the following rooms : private offices for the principal and

secretary; a general office; a typists' office; and a store for stationery and records. These rooms should be planned as near to the main entrance as possible, and the general office should have a counter for inquiries and for the sale of stationery.

Heating and Ventilating

Natural ventilation is usually sufficient in all classes of school building, but despite the prejudice which exists against the mechanical ventilation of schools, such a system may be essential where a school or college is situated on a noisy thoroughfare, and the ventilation by means of open windows would be objectionable.

Various methods of heating have been adopted, and it may be said that practically all systems of heating which are suitable in other types of buildings may be used in schools. Generally speaking, however, low-pressure hot-water heating with radiators and circulating pipes has been the most popular. Radiators placed against external walls under windows, and with fresh-air inlets behind the radiators, will provide a satisfactory system of heating and ventilating in winter, and this system possesses obvious advantages over steam heating in that children are not likely to be burned when coming in contact with pipes and radiators.

The various forms of low-pressure hot-water panel heating have been employed with varying success. The system is more costly to install, but possesses obvious advantages in that walls are free from pipes and radiators, thus facilitating the installation of various kinds of equipment.

Conclusion

The foregoing notes touch but briefly upon the many problems involved in the planning of various kinds of schools. The illustrations show plans of a few schools erected since the War, and they exhibit various satisfactory arrangements of rooms.

As with all other aspects of architectural design, it is important to examine carefully the plans of all new school buildings, many of which will show interesting experiments and departures from generally accepted plan forms in the solution of special problems.

Most elementary and secondary schools have much in common, and may be more or less standardised in many of their aspects, but in the planning of schools for technical purposes the closest possible co-operation with the teaching staff concerned is essential, since the success of the teaching to be carried out will depend very largely upon the efficiency of the planning in relation to the elaborate equipment frequently required.

QUESTIONS AND ANSWERS

What accommodation is usually required for Domestic Science in Colleges specialising in training for Women ?

It may include all or some of the following :—

(1) Needlework and dressmaking rooms.
(2) Fitting room.
(3) Cookery rooms equipped for various branches of the work.
(4) Cookery demonstration room.
(5) Housecraft room.
(6) Laundry.
(7) Upholstery room.
(8) Rooms equipped for home arts and crafts.

How should the working tables or benches be arranged for Housecraft Rooms ?

They should be arranged to face the teacher's desk, or in the form of a hollow square, the students working on the outside and each, therefore, being under the immediate supervision of the teacher, whose demonstration table is in the centre of the square.

What should be the minimum size of a Science Room in an Elementary School ?

Nine hundred feet super for a class of forty, with an adjoining preparation room and store of about 200 ft. super. If these rooms are combined, an area of about 1,000 ft. super may suffice.

What size allowance is required in Secondary-school Science Rooms ?

An allowance of about 30 sq. ft. per student.

What are the requirements of a Laboratory for the teaching of Botany ?

A south aspect is essential, and one of the windows should be fitted with a cabinet for growing plants.

What are the essentials of an Art Room for forty students ?

(1) An area of at least 900 ft. super.
(2) Preferably a square room.
(3) A north light, provided by one large window or a centrally placed group of windows not less than 12 ft. high.
(4) Windows which admit sunlight should be fitted with curtains or blinds.
(5) Ample storage space.
(6) One or two sinks.

What should be the minimum width of Corridors ?

Seven feet.

GROUPED HOUSES AND HOUSING SCHEMES

Fig. 1.—Woodhall Court, Welwyn Garden City

A view of the close from the south-west, showing the use made of old trees, and new planting. (*Architect: A. W. Kenyon and Louis de Soissons, FF.R.I.B.A.*)

OPPORTUNITIES for designing houses in architecturally self-contained groups occur in the work of public utility societies and in the developments carried out by such companies as Welwyn Garden City Ltd. Many cottage housing schemes of local authorities are also conceived on similar lines, as are their rehousing activities under the slum clearance and abatement of overcrowding legislation.

The former groups are intended for the middle and working class tenants or owners, while the latter, being built for the most part with the help of some form of subsidy, are for renting to lower-paid workers.

There is a distinction between work in the above categories and houses built by the speculative builder, who is all too seldom able to lay out a

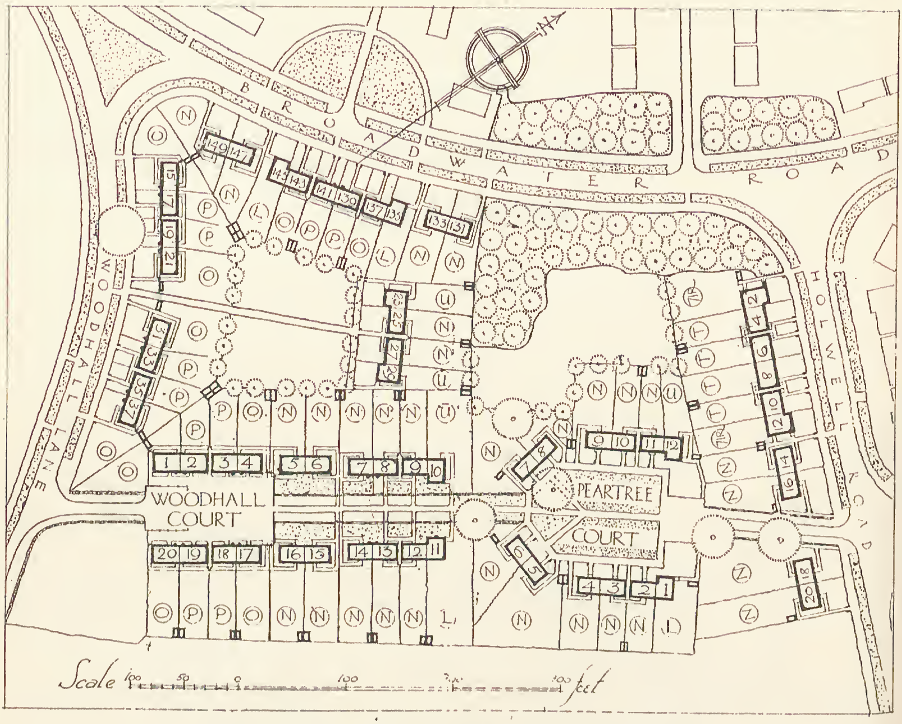


Fig. 2.—Two courts at Welwyn Garden City

Showing varied types of layout and the imaginative use of tree planting. The larger trees shown are old ones, which were allowed to influence the lines of development.

complete scheme. His work, even when good in detail, is not often sufficiently co-ordinated to form satisfactory groups. To achieve this result it is necessary to have in mind from the start how the scheme will look when completed.

Architectural and Practical Possibilities

There are architectural possibilities in grouped work which are absent from most projects for separate private houses. Larger-scale planning is possible when twenty or more houses are concerned, and an almost endless variety of courtyards, closes, and groupings around greens or gardens on either side of a main road. Such schemes permit of continuous walls and roofs, which make both for economy and for a restful appearance.

There are important practical advantages associated with grouped houses, among which is the possibility of placing the houses off the main road and separated from it by a children's playground or ornamental garden, around which runs the access roadway. Such an arrangement

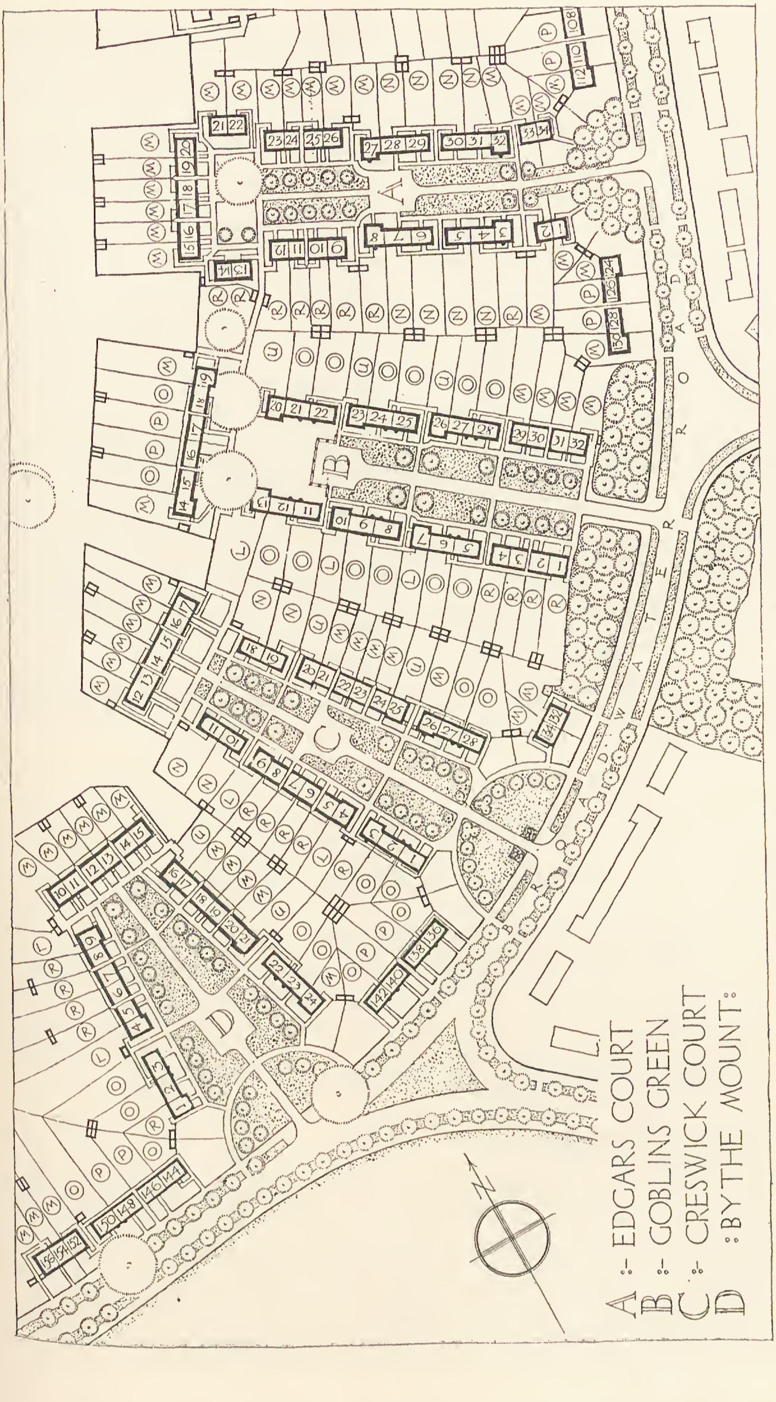


Fig. 3.—Showing four closes at Welwyn Garden City

Note the interesting shapes suggested by the sweep of the road, and the enclosed effect of each group produced by the buildings at the end of the close extending beyond the line of the side blocks.

Fig. 4.—Attimore Road, Welwyn Garden City

Group of six houses, the walls of which are rendered and distempered cream. The unity of the composition is enhanced by the roadside planting in front of the houses—a more pleasing arrangement than the ordinary front gardens of varying layout. (*Architect : C. H. James, F.R.I.B.A.*)

provides the minimum interruption to through traffic on the main road from stationary vehicles serving the private houses. It also secures to the residents some protection from traffic noise, and gives them a pleasant outlook of gardens or trees.

In the planning of the blocks it is necessary to avoid ill-lit rooms in the corner houses, which occur if the angles of the courtyard are built up solid. Examples at Welwyn Garden City illustrate interesting solutions of this problem, and it will be seen that the effect of a " close " has been obtained by running the block at the end of the group well beyond the front face of the wall of the houses on either side.

A Model for Grouped Development

There can be few better examples of small-house development than Welwyn Garden City, where Mr. de Soissons' layout and planting schemes form the groundwork for the delightful roads, closes, and culs-de-sac which Mr. Kenyon and he have designed. Certain housing schemes, and a few of the closes (promoted for the most part by the public utility societies) have been designed by other architects in consultation with Mr.

Fig. 5.—THE ORCHARD, WELWYN GARDEN CITY

The effectiveness of this close is due to its planning around old trees, and to the interesting roof design with recessed and partly projecting dormer windows. (*Architects : A. W. Kenyon and Louis de Soissons, FF.R.I.B.A.*)

de Soissons and Mr. Kenyon; as a result of this arrangement, the whole town has an architectural unity in spite of the variety of the detail work. The block plans of Peartree Court and Woodhall Court, and of the group of four culs-de-sac, illustrate how both economy and charm can be secured.

Economy

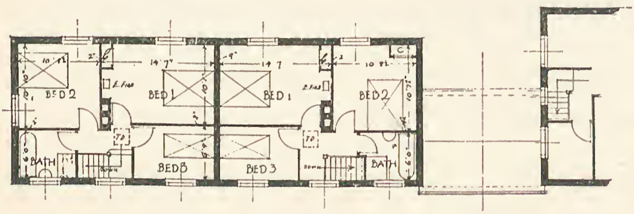
Great savings in road-construction costs result from this method of planning because, instead of an 18- or 24-ft. roadway, it is adequate to provide a 10-ft. carriageway with a turning-space at the end of the group. "Back land" is used effectively, and the minimum inconvenience due to traffic noise is ensured.

Some Features of Closes at Welwyn Garden City

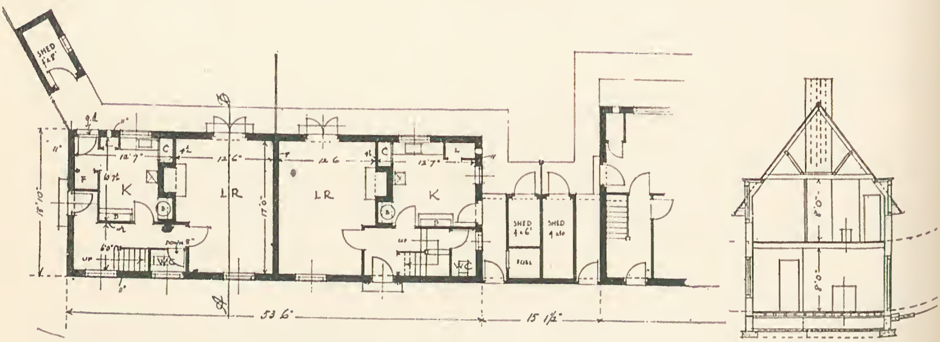
Every natural advantage has been utilised in the planning of the closes shown in Fig. 3. Among these is the bend in Broadwater Road, which suggested the tapering of Goblins Green, Creswick Court, and

Fig. 6.—PARKWAY, WELWYN GARDEN CITY

Showing how the grouping of small houses may secure a most dignified effect, appropriate for a central position in a new town. The layout plans and working drawings, Figs. 6A–C and 9, illustrate how the houses are separated by means of sheds and how garages serving the houses may be grouped together. (*Architects: A. W. Kenyon and Louis de Soissons, FF.R.I.B.A.*)



First Floor



Ground Floor

Section A—B

Fig. 6A.—PLANS OF HOUSES 1 AND 2, PARKWAY, WELWYN GARDEN CITY

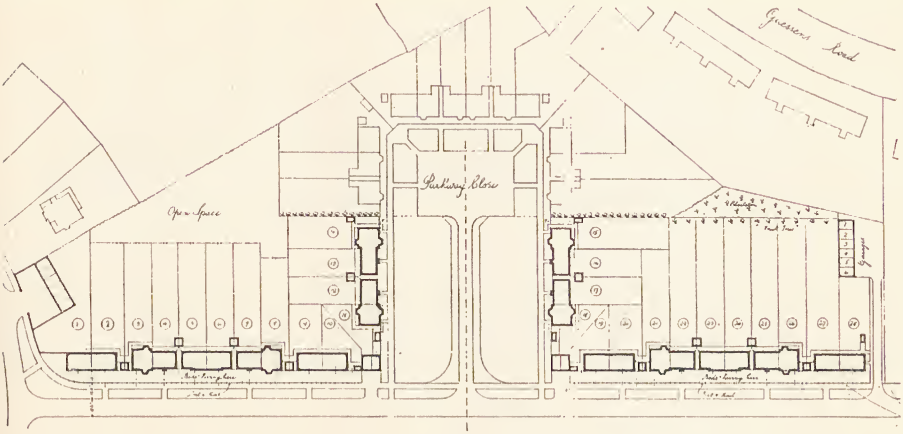


Fig. 6B.—GROUPED HOUSE SCHEME, PARKWAY, WELWYN GARDEN CITY
Twenty-eight houses. (*Architects : A. W. Kenyon and Louis de Soissons, FF.R.I.B.A.*)

By-the-Mount, giving a pleasing openness. Existing trees as in Peartree Court have been retained, and the line of roads and positions of houses are arranged to suit them. There are no untidy buildings, since sheds have been designed as part of the scheme, and are usually of elm weather-

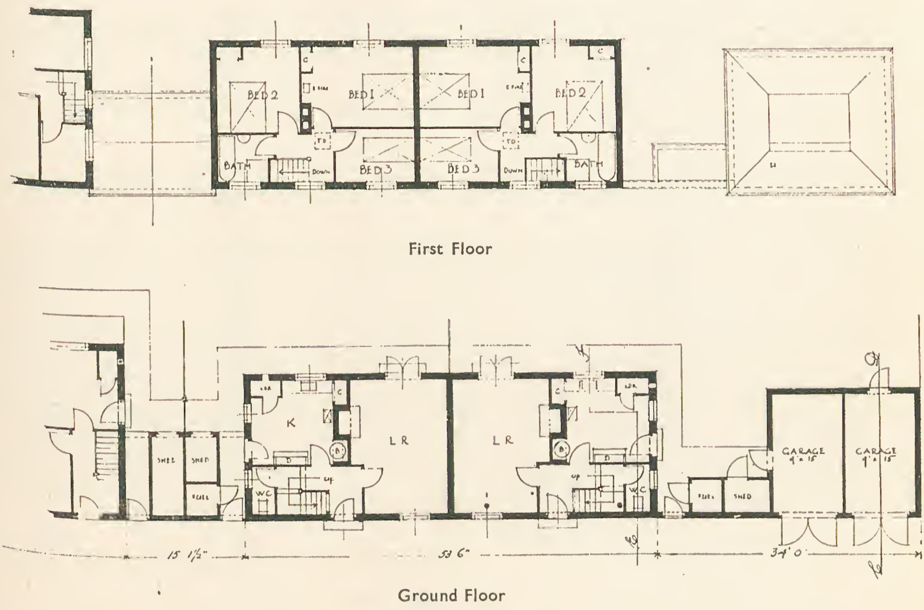


Fig. 6C.—PLANS OF HOUSES 9 AND 10, PARKWAY, WELWYN GARDEN CITY

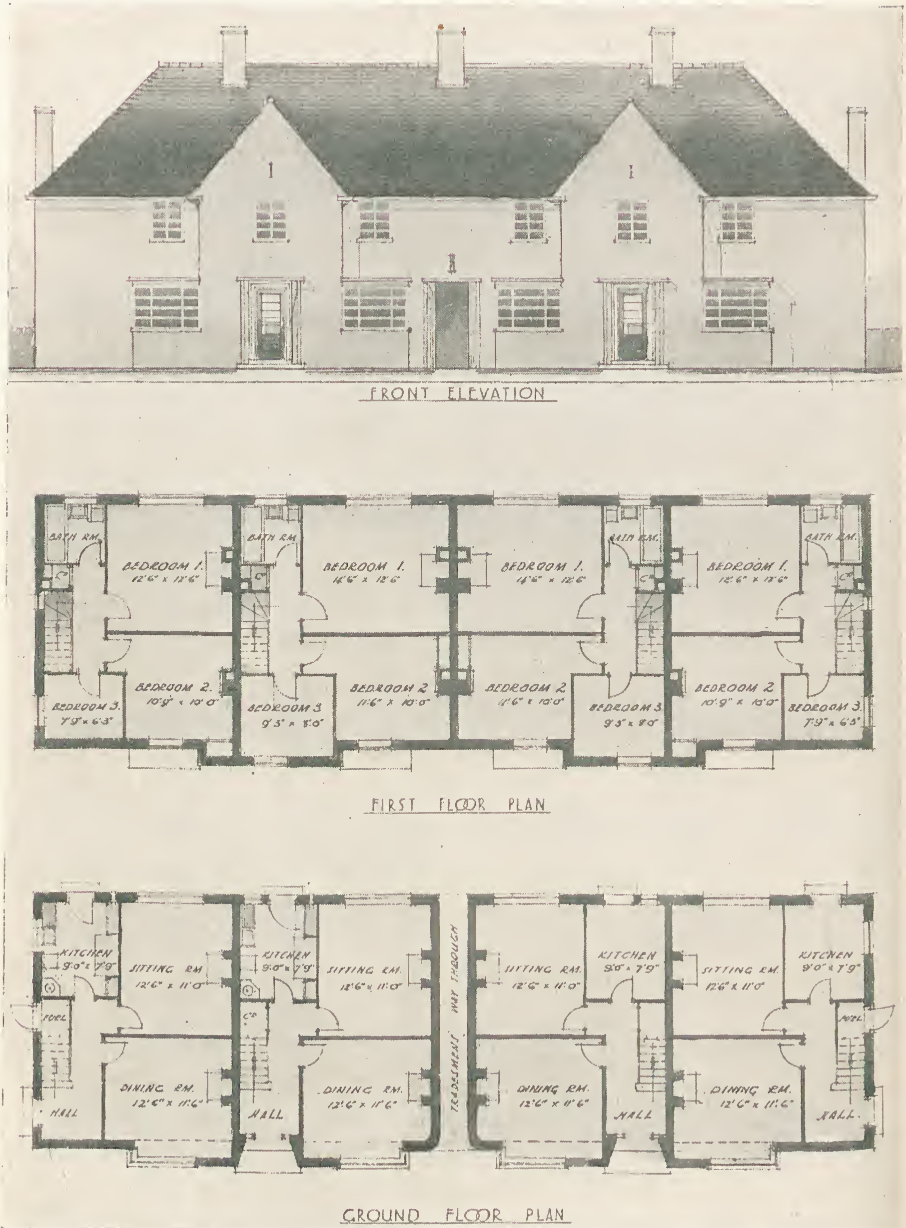


Fig. 7.—A PLEASING GROUP OF FOUR HOUSES, KINGSCROFT ESTATES, DUNSTABLE

Note the original type of bay window. (*Architect: Frank T. Winter, A.R.I.B.A.*)

boarding with tiled roofs. When an owner wishes to erect additions or outbuildings, he is required to submit a drawing for the estate architect's approval.

Designing in Harmony with Existing Trees—

The planting is a notable feature of these developments, and it will be seen, for instance, that the trees to the north of Woodhall Court screen the back gardens from the approach to homes 23 to 29, giving a sense of privacy to them. A view of this Close is given, showing in the distance several old trees which were incorporated in the design. Groups of trees form thick spinneys on either side of Broadwater Road, and give individuality to the adjacent houses. How different is this type of design from the late Victorian idea that the function of art was to put Nature straight!

—and with the Lie of the Land

Another aspect of small-home development is the need to conform as far as possible with the contours of the land. Here again economies of construction are achieved with enhancement of appearance, not to mention ease of gradient for traffic.

Variety of Building Materials

The photographs of the Welwyn Garden City houses show the interesting use made of building materials—tarred deal or plain elm weather-boarding, limewashed or rendered brickwork, concrete blocks and facing bricks of various colours. The front entrances are sometimes roofed in metal shaped to a hollow curve. The supports are of concrete, wood, or brick. Several types of porticos are shown in the photographs of Attimore Road, Woodhall Court, and the Orchard.

A Group of Urban Character

Near the centre of the town are some small houses built in terraces along Parkway. The illustration shows one group which for varied charm yet compact unity has much akin with the best of the fine urban buildings of the eighteenth century. The layout plan and working drawings show how terrace houses may be separated by means of sheds, and how garages serving the houses may be grouped together.

An Original Elevation

A pleasing group of four houses at Dunstable illustrates several points of design. The front doors are emphasised by their being surmounted by gables, and being set between two bay windows of an original type. These windows avoid the mistake of facing the path to the front door, and so secure privacy in the rooms.

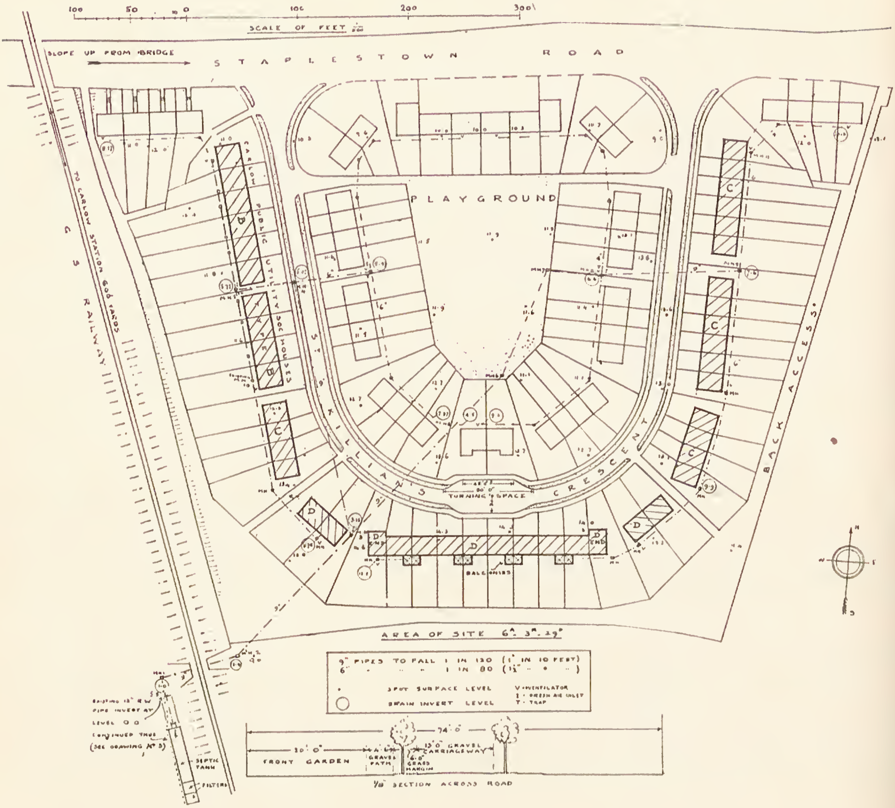


Fig. 8.—CARLOW URBAN DISTRICT COUNCIL—LAYOUT FOR EIGHTY-EIGHT HOUSES
(*Architect : Manning Robertson, M.R.I.A.I., F.R.I.B.A.*)

HOUSES FOR LOWER-PAID WORKERS

There are similar possibilities of good grouping in connection with council housing schemes. They give sometimes even more scope in this direction, since the public authority are in a position to acquire large sites which can be economically served with sewerage and other facilities operated by the local authority itself. Where a playground, allotment, or public park is required, the scheme can be laid out to utilise suitable areas for these purposes. An example of this is shown in the Carlow housing scheme, where the back land serves as a playground.

The Maldon scheme illustrates two culs-de-sac. The whole scheme is planned off the traffic road and has a two-way road access from the latter. This arrangement appears to be logical, since most of the tradesmen's daily vans require to visit a number of houses without re-passing in front of them.

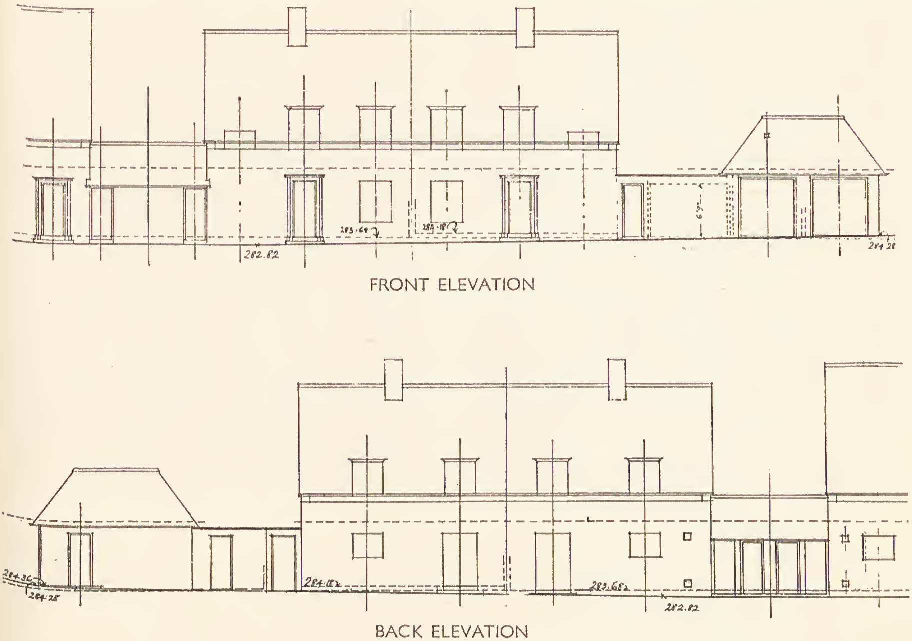


Fig. 9.—FRONT AND BACK ELEVATIONS OF HOUSES 9 AND 10, PARKWAY, WELWYN GARDEN CITY

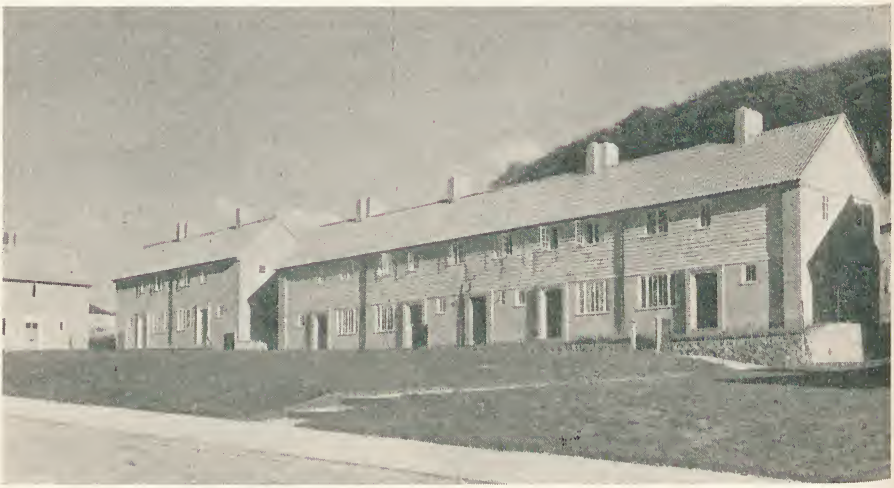
These illustrations show how terrace houses may be separated by means of sheds and how garages serving the houses may be grouped together. The plans are given in Fig. 6c.

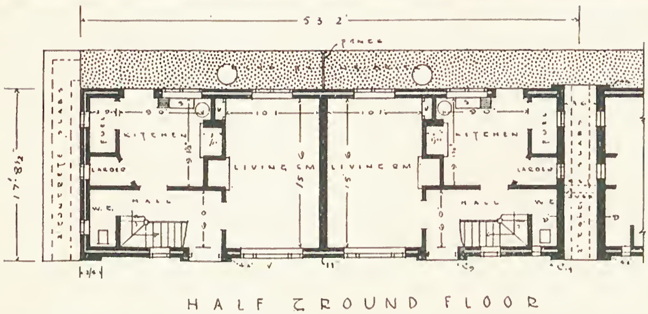
The Problem of Access to the Kitchen Entrances

Where more than two homes are built in a block it is desirable to provide access to a back door either by a passage through the building, as at Maldon and Wollescote, or by a back roadway. The latter method is open to the objection that the approach becomes untidy, and the police find that supervision is rendered difficult; such means of access requires, but often does not have, proper artificial lighting, and while being wasteful of space it is also a tortuous means of approach to the houses. Occasionally—as at Tolpuddle—where there is a small scheme intended for selected tenants, there is no objection to the tenants of the inner houses passing the back doors of the outer ones. This obviates the need for either a back roadway or a passage through the block, and the appearance of the scheme thereby gains considerably.

Front Gardens

A further advantage in a case like the last example—built by the Trades Union Congress for elderly workers who have spent their active lives as agriculturists—is that the whole of the space in front of the





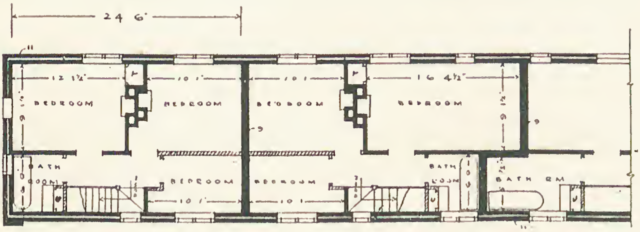
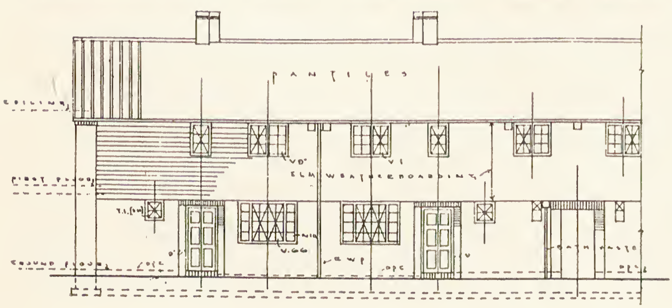
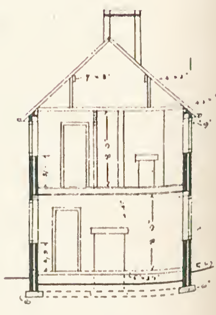


Fig. 10.—HODGE HILL FARM HOUSING, WOLLESCOTE, STOURBRIDGE

Block of four houses. Left of picture, a block of two houses. Walling: Old Worcestershire rustic facings, unstained elm boarding. Roofs: Double Roman sand-faced pantiles.

(*Architects: Folkes & Folkes, F/A.R.I.B.A., Stourbridge.*)





cottages can be treated as a single garden. There is a wide grass slope down to the road—the bank in front of the approach to the houses serving as a fine flower bed. The back gardens are cultivated as allotments by the six families, and no hedges between them are required. The Welwyn Garden City examples show several similar planting arrangements. Attimore Road is greatly enhanced by the roadside gardens, which ensure that the whole road shall have a unified tidiness.

Council Housing Schemes

The planning of the worker's house is largely controlled by Government housing policy and by the fact that the lower-paid workers cannot afford to pay an economic rent. This factor has the effect of lowering costs to a point which often cannot provide a well-built house of adequate size. This type of accommodation varies little, whether built by public utility societies or local authorities, since for reasons of cost the accommodation has to be kept to a minimum. Where Government and local authority contributions are available under slum clearance or abatement of overcrowding provisions, payments are now made on the basis of the number of persons housed. This has the effect of reducing housing costs per head to the minimum consistent with modern ideas as to how the poorer section of the population should live. The 1936 Act requires, for instance, that a fixed bath in a bathroom shall generally be provided.

Housing Overcrowding Standards

Overcrowding, as laid down in Section 58 and Fifth Schedule of the 1936 Housing Act, means an insufficiency of floor space and of the number of rooms in a house in relation to the number of persons living in it. The effect of these provisions is that an ordinary three-bedroom non-parlour house, such as shown in the Maldon housing plan, with an internal floor area of 760 sq. ft., might accommodate the following family :—

Bedroom 1.—Father and mother and infant under one year.

Bedroom 2.—Adult and child under ten of same sex.

Bedroom 3.—Boy or girl under ten.

Living-room.—Two adults of same sex or one adult and two children of same sex or four children of same sex.

Kitchen (if it is used as a living-room in the locality).—One adult and one child under ten of same sex.

Thus, assuming the kitchen be deemed a living-room, we have a possible family of six adults, three children under ten, and one infant, or four adults, seven children, and one infant. In the more probable case in which the kitchen is not deemed to be a living-room, there would be a possible family of four adults and four children under ten, and an infant. Even on the latter assumption it would still be necessary for members of

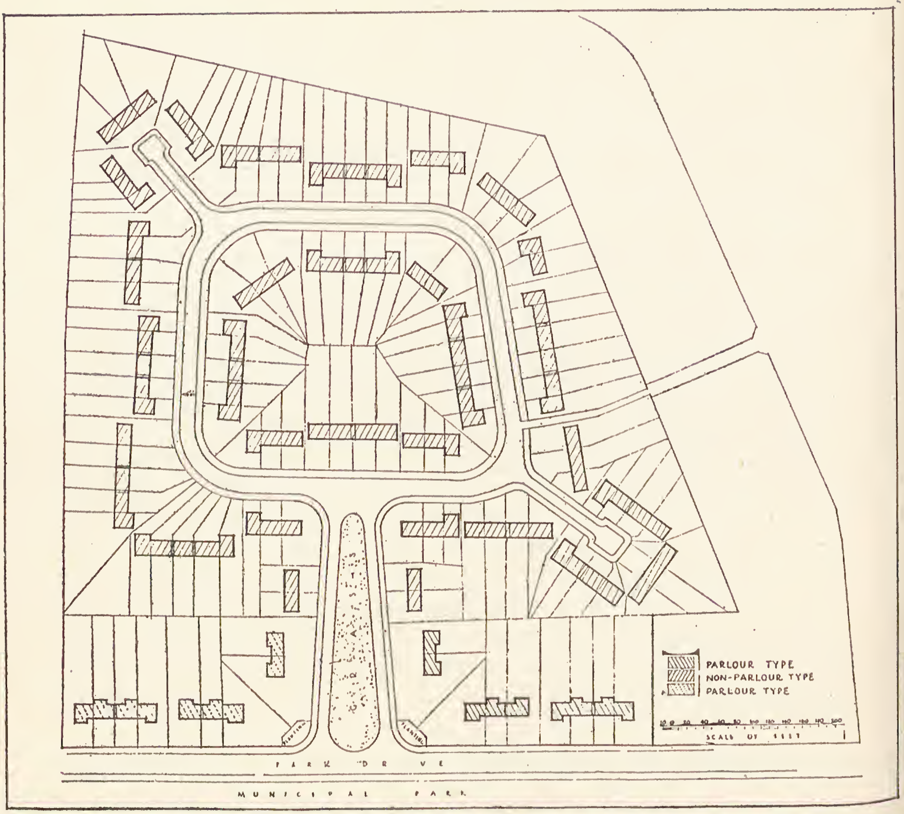


Fig. 11.—MALDON, ESSEX, PARK DRIVE HOUSING SCHEME
(*Architect: The late Edward Unwin, A.R.I.B.A.*)

the family to sleep in the living-room, with all the inconvenience which this involves.

An Improved Standard Required

It is hoped that Parliament may before long alter the definition of overcrowding, so that the living-room shall not be included in the calculation. We should then have a reasonable standard of a family of seven (father and mother and four children and one infant) as the maximum family to be housed in a three-bedroom house of 760 sq. ft.

The Size of House Required

Since the average number of persons per family is unlikely to increase from the present figure of four, we may consider that the provision of three bedrooms would seem to be a generous allowance for the

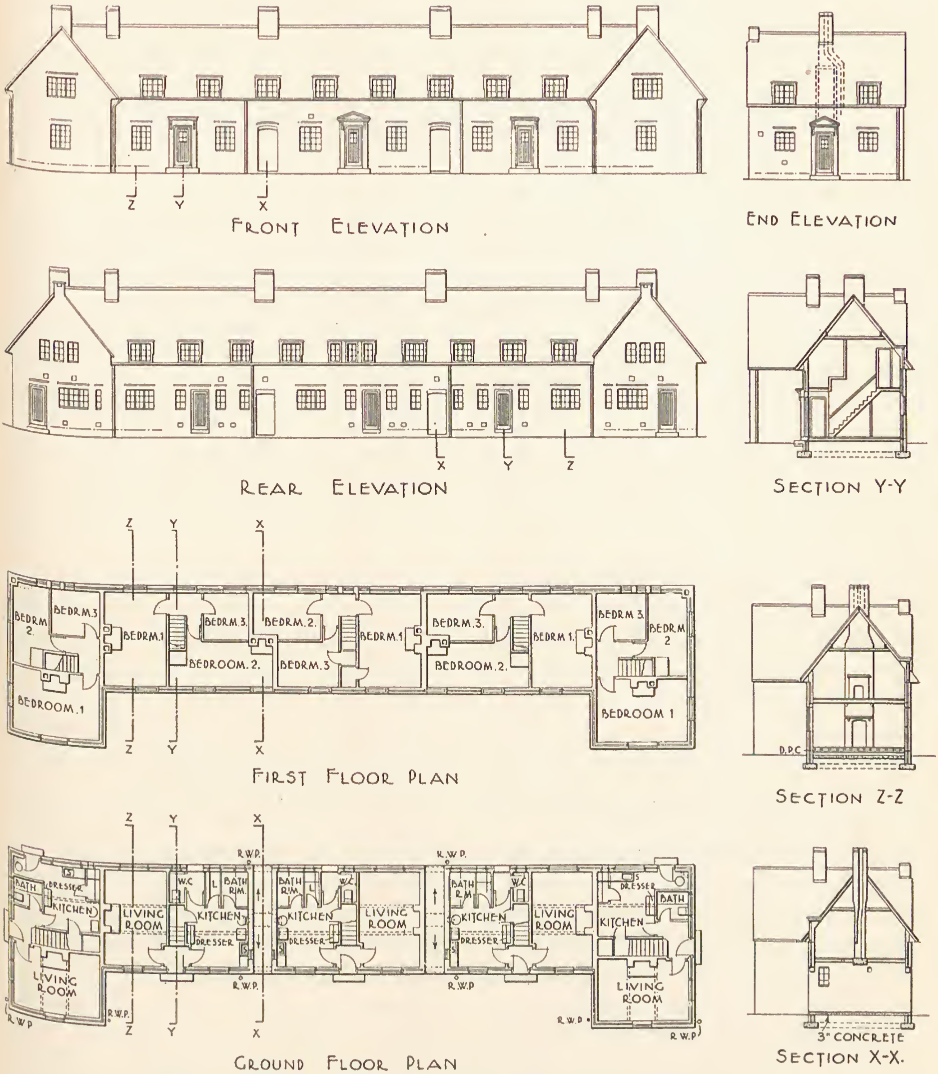


Fig. 12.—HOUSES IN MALDON PARK DRIVE HOUSING SCHEME

Note the two positions of the bathroom, one off the entrance hall and the other off the kitchen. (*Architect: The late Edward Unwin, A.R.I.B.A.*)

majority of families. A few larger houses, and some with two bedrooms, should be included where the demand can be calculated in advance. Where too many rooms are provided the spare ones are normally let to lodgers. In slum and decrowding schemes, such a forecast can be made approximately, but it is by no means certain that the displaced tenants

will remain to the new accommodation, and a change of family units may therefore occur.

These considerations lead to the conclusion that the basic type of accommodation should be three bedrooms, living-room, and kitchen. The disposition of rooms should vary according to aspect.

Types of Plan

A " through " living-room may not always be the best arrangement, though it is generally the most useful. It provides for a view to the front which is still often preferred—irrespective of aspect—and should this be to the north, it follows that ample sunlight will enter at the other end of the room. For east- and west-aspect houses, the through room ensures sunlight almost throughout the day.

An alternative for north-facing cottages is a living-room along the sunny garden side, and a scullery to the front. This, however, is not generally popular on account of the preference for a road view from the living-room, and also because ladies do not like to be seen working at the sink !

The Position of the Bathroom

It is sometimes difficult with houses of this minimum size to place the bathroom on the first floor. Where this cannot be arranged, the bathroom is best planned off the entrance hall (see Fig. 12). In this position, the w.c. may be in the bathroom, whereas when the latter opens off the kitchen (Fig. 12) the w.c. must be separated from it and approached from the kitchen lobby. This is not an ideal arrangement, especially where there is a lodger, and in any case the access to the w.c. is draughty.

In the Wollescote scheme a convenient plan has been contrived which provides for a first-floor bathroom ; this type is, however, only suitable for a north or west aspect, since only one bedroom faces the front, which is mainly occupied by staircase, bathroom, and w.c. This plan is a good one also in that the fuel store is near the kitchen door, which minimises the inconvenience of coal grit being trodden about the floor.

The external treatment of council houses tends to be simple, though if good bricks and sand-faced tiles are used, and the openings are well placed, the effect can be very pleasing. The introduction of elm weather-boarding, as at Wollescote, and the low roof eaves as at Tolpuddle (see page 238), add a distinctive note. The main advantage of grouped schemes is that a certain breadth becomes possible which is lacking in the small detached house.

THE DESIGN AND CONSTRUCTION OF THEATRES

UNTIL about twenty-five years ago, the planning and designing of theatres appears to have been treated as a ritual adopted during the early part of the seventeenth century. Such ritualistic conception of a theatre is not dead yet, but it is certainly the worse for wear. To-day, unless architects acquire some technical knowledge, not to say experience, of theatrical production, they are unlikely to visualise contemporary requirements, much less contribute any impulse to the theatre as a place for seeing and hearing the manifestation of human ideas in terms of unreality.

The Traditional Theatre

For more than two hundred years past, the most tenacious characteristic of theatre planning has been the stage, invariably separated from the auditorium by a proscenium arch or theatrical picture frame ; the auditorium has been planned with an eye to what may be termed, in architectural parlance, a dominant axis of observation which provides an ideal view of the stage for one particular individual seated in the auditorium. This traditional form of theatre has naturally established traditional stagecraft, traditional scenery, and, with all due respect, traditional actors, producers, and playwrights. Without wading through historical transition, say from the theatre of ancient Greece to that of the present day, there is not much doubt that ever since the Greeks paid homage to Dionysus, experimental stage scenery has had much to do with the history of actual theatre design. At any rate, it is not unreasonable, though somewhat unusual, to consider stage planning and equipment as the beginning and not the end of modern theatre design, because the stage determines the kind or variety of production that may be produced in a theatre ; whereas the function of the auditorium is to enable so many persons to witness what is produced. Obviously the designer of contemporary theatres should be prepared to evolve whatever kind of structure circumstances dictate, be it for traditional, transitional, or experimental purposes only.

The Modern Theatre

The amount of novelty that may be embodied in modern theatre design is questionable, and often too readily assumed. The theatre is ageless, and that of the ancients was more complete in plan and principle

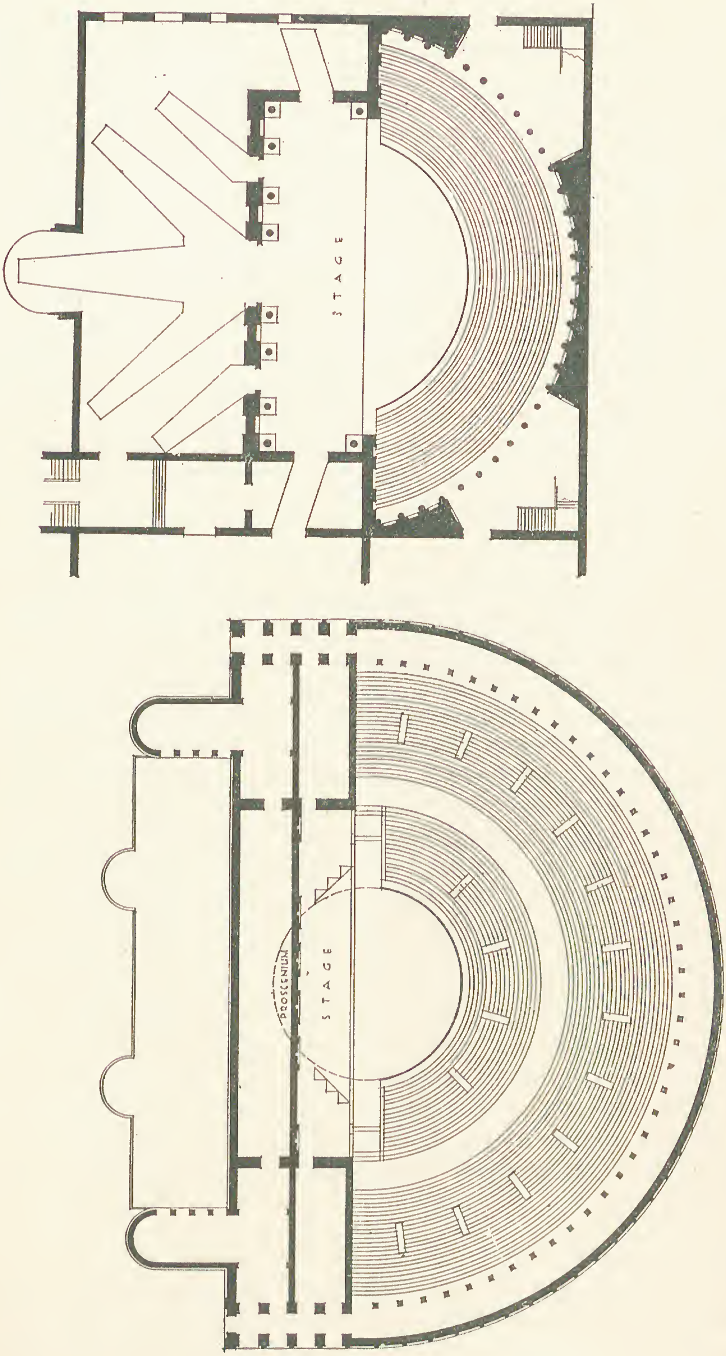


Fig. 1.—PLAN OF THEATRE OF MARCELLUS (ROMAN) COMPARED WITH TEATRO OLIMPICO, VICENZA (RENAISSANCE)

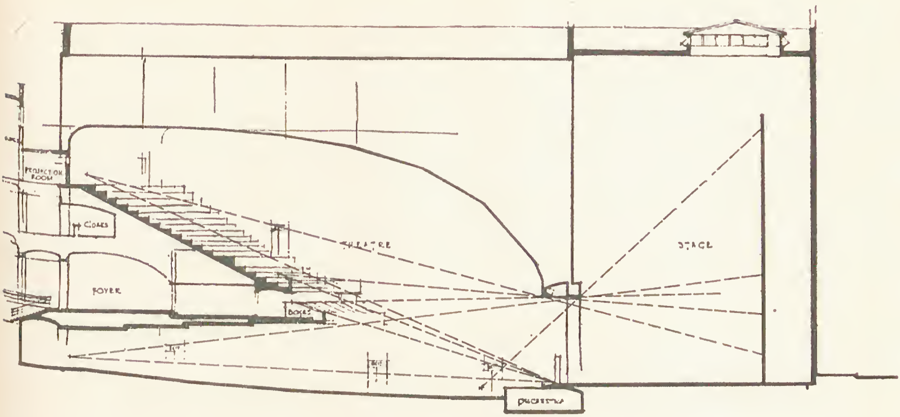


Fig. 2.—CHARACTERISTIC SIGHT-LINES

of presentation than the majority of theatres to-day. The most ambitious attempts and proposals to modernise the contemporary theatre inevitably reveal some reversion to its first principle, only, of course, beneath a roof instead of the sky, aided by more elaborate machinery than was available before the Christian era. It is, therefore, methods rather than principle that contribute innovation to what is conveniently described as a modern theatre. The modern theatre designer is bound to study the ancient theatre and, if possible, explore what remains of it in Athens, Syracuse, Taormina, and elsewhere. Those remains reveal, far more than printed matter will ever convey, the fundamental principle of theatre planning and design conceived on the shores of our western civilisation.

The Transitional Theatre

Theatre planning and design can be quite practically classified in three orders, namely, classical, traditional, and transitional. Some participants in theatrical enterprise to-day will have it that there is an experimental theatre, as though experiment were something outside the scope of what is, actually, a vehicle for all sorts of human experiment. The traditional theatre, typified during the past three centuries and with us yet, is a rather dilapidated segment of the classical theatre, a fragment of ancient inspiration, maintained by dramatists and performers who deserve a better home. That need may be met by the transitional theatre, adaptable to contemporary conditions and a variety of purposes by adjustable stage and seating accommodation, mechanical and other aids to any form of entertainment that may be desired. Such a theatre envisages the film, radio, and television as part of its transitional purpose ; instead of being an experiment it is designed for endless experiment. Little theatres, including amateur, school, university, and private theatres, are, after all, offsprings of the theatre proper ; transmission of sound

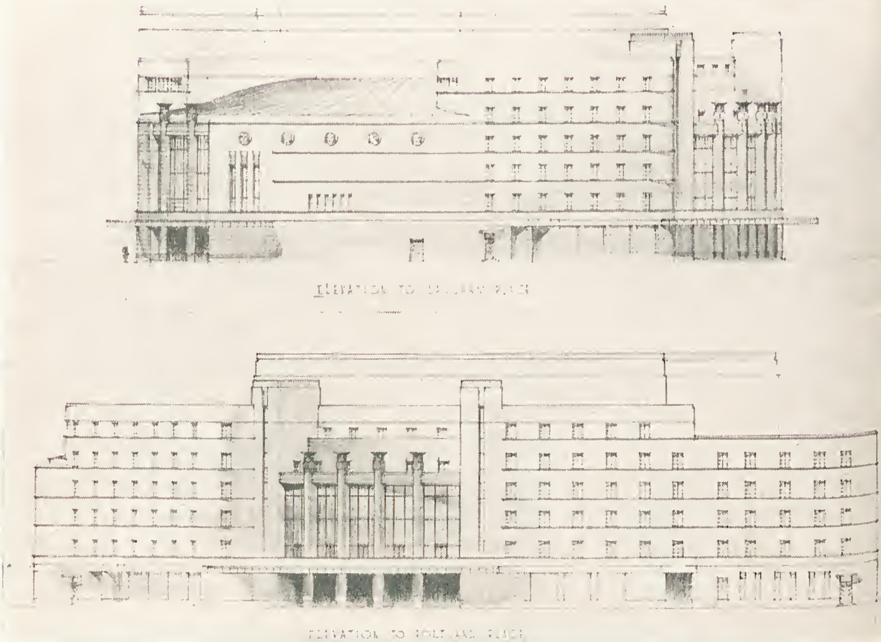


Fig. 3.—PROJECT FOR IMPERIAL MUSIC CENTRE, LONDON
(*Architect : Oliver P. Bernard, L.R.I.B.A.*)

and vision promises to make every home into a little theatre, so that theatrical inspiration may be laid on from productive sources like water, gas, and heat.

Propositions for the Theatre Stage and Auditorium

Building any kind of theatre impels some consideration of human and mechanical factors, apart from conditions laid down in Building Acts and by local authorities. The kind of theatre that may be contemplated could include any or all of the following propositions :—

Structural and mechanical unity between stage and auditorium, as a factor of intimacy between dramatic action and audience.

Mechanical apparatus for converting part of auditorium into continuation of stage, and for converting stage and auditorium into water tank, etc.

Stage and auditorium to share, as closely as possible, dramatic, scenic, and lighting effects.

Lighting effects to emanate from auditorium as well as stage, with other apparatus for projecting scenic effects around auditorium as well as towards stage.

Film and sound projection, and some investigation of television requirements.

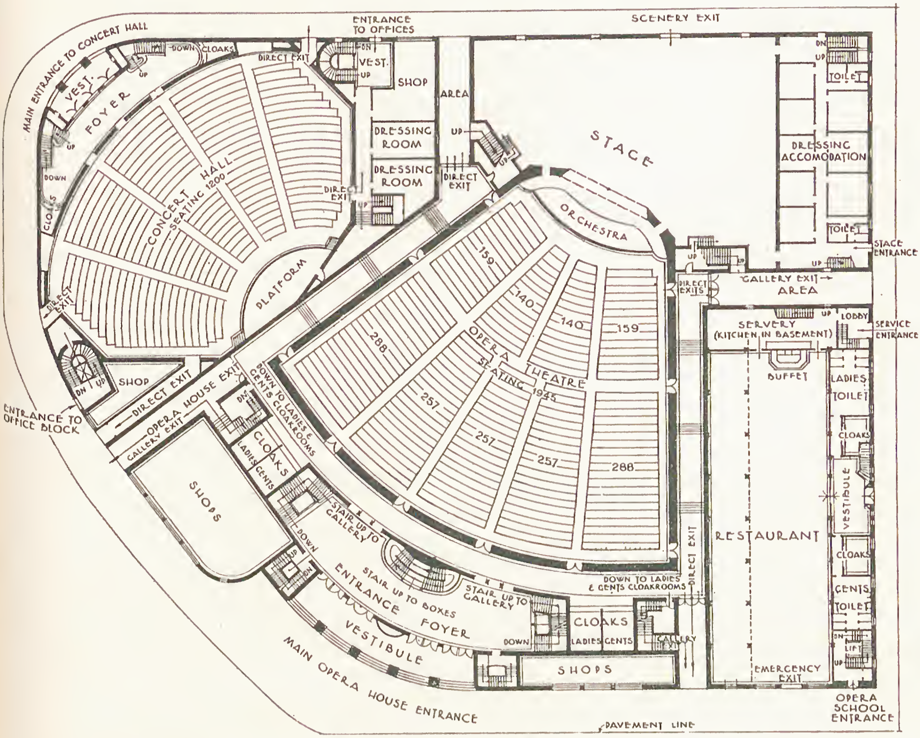


Fig. 4.—GROUND-FLOOR PLAN OF PROJECT FOR IMPERIAL MUSIC CENTRE
(*Architect : Oliver P. Bernard, L.R.I.B.A.*)

Changeable stage levels and mechanically movable sections or stages to facilitate rapid change of scenes with or without interruption of performance.

Means of entrance and exit for actors, horses, etc., in auditorium.

The foregoing propositions aim at the first principle of theatre planning, which should enable an audience to see, hear, and experience dramatic, musical, and other effects or illusions to the fullest possible extent. Any effort to satisfy those propositions must begin with the planning and design of the stage itself ; moreover, such effort inevitably leads to some resurrection of the classical theatre wherein audiences were seated in nearly circular formation round the stage, instead of in front of the traditional proscenium or theatrical picture frame.

Building Regulations for Theatres

Building a theatre in any circumstances necessitates compliance with building regulations that are common to all places of entertainment. The requirements embodied in such regulations are enumerated in official publications issued by the London County Council and other civic authorities, in addition to the London Building Act. So much official informa-

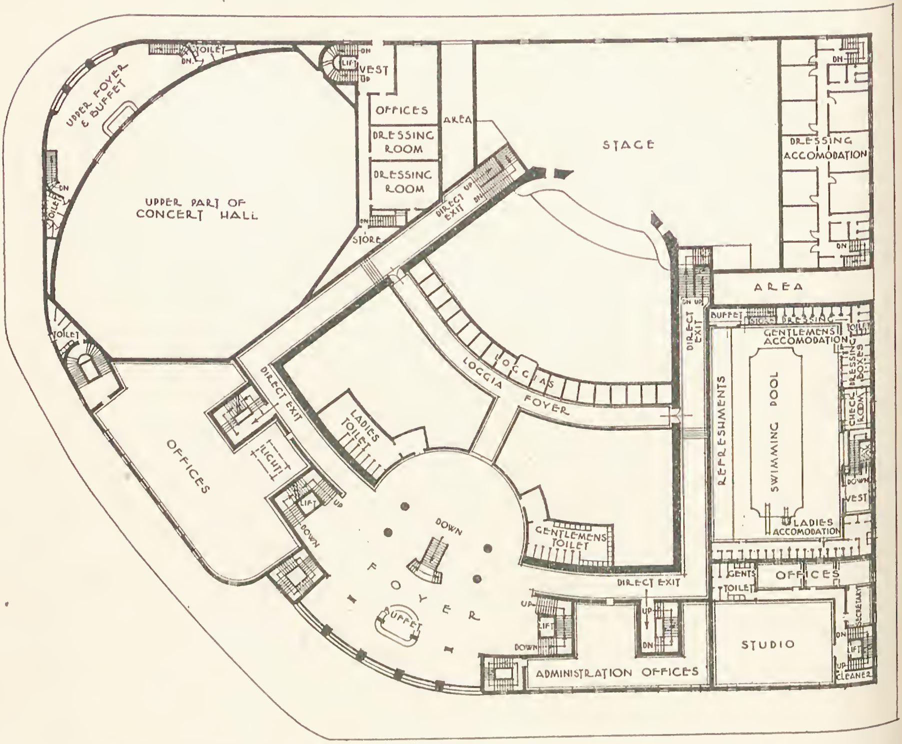


Fig 5.—First-floor plan of project for Imperial Music Centre
(*Architect : Oliver P. Bernard, L.R.I.B.A.*)

tion need not be repeated in this article, but one may say that these regulations represent wisdom and experience for the protection of the public and of builders as well. It is the spirit as much as the letter of those regulations which requires studying in relation to theatre design. For example, official authorities stipulate minimum requirements, but a minimum is not necessarily comfortable, though commercial interests are apt to rate a minimum of anything as more than enough to satisfy authorities and patrons alike.

Auditorium

A theatre is intended to accommodate a given number of people. The first and last function of its plan is to get so many people into and out of the auditorium—safely and comfortably. Steps and stairways in any place of amusement should occur only through sheer necessity. Ramps, sloping floors, are preferable to steps where necessary and convenient. The ideal auditorium is one which allows the audience to walk in and out on one and the same level as the street outside the theatre. The first

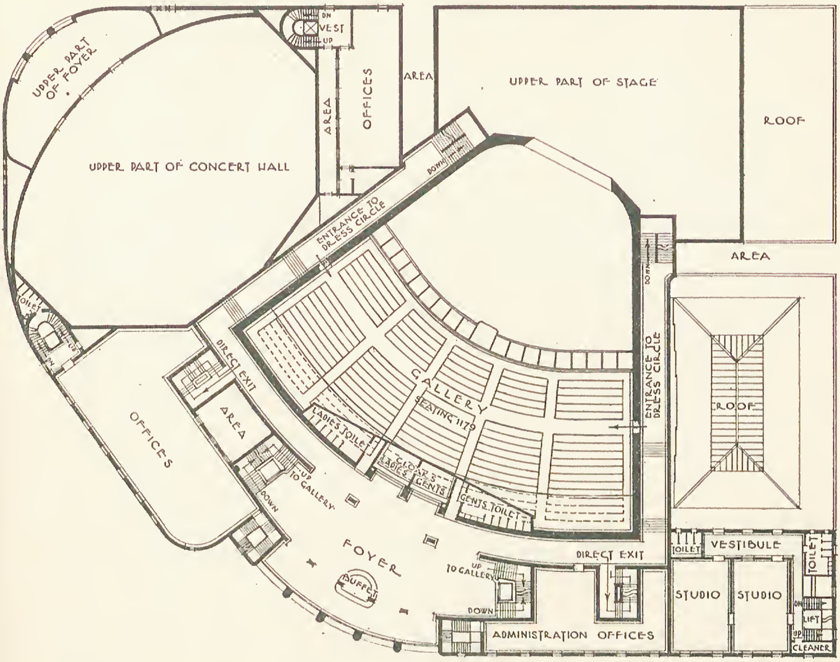


Fig. 6.—SECOND-FLOOR PLAN OF PROJECT FOR IMPERIAL MUSIC CENTRE
(*Architect : Oliver P. Bernard, L.R.I.B.A.*)

essentials of an auditorium are, therefore, safety and comfort, and the next step is to provide visibility.

Visibility of Stage

It so happens that visibility, comfort, and safety are invariably associated with seating plan and seating levels of the auditorium in relation to plan and level of the stage. A level auditorium, of course, impedes visibility of the stage, so the rake or slope of the auditorium is determined by its relation or continuity with the stage, by the distance of its extreme margin from the stage, and by the projection of balcony, if balcony there must be, above the auditorium.

One may naturally begin the plan of the auditorium by deciding that the stage shall not be so high as to compel the nearest spectators to tilt their heads back. As a matter of opinion, the stage level might well be below rather than on the eye-level of those seated nearest the stage, say 35 in. above the auditorium floor.

Placing the Seats

The comfortable inclination of the auditorium floor should not exceed 1 in. to 1 ft., and a parabolic inclination is less noticeable than a straight

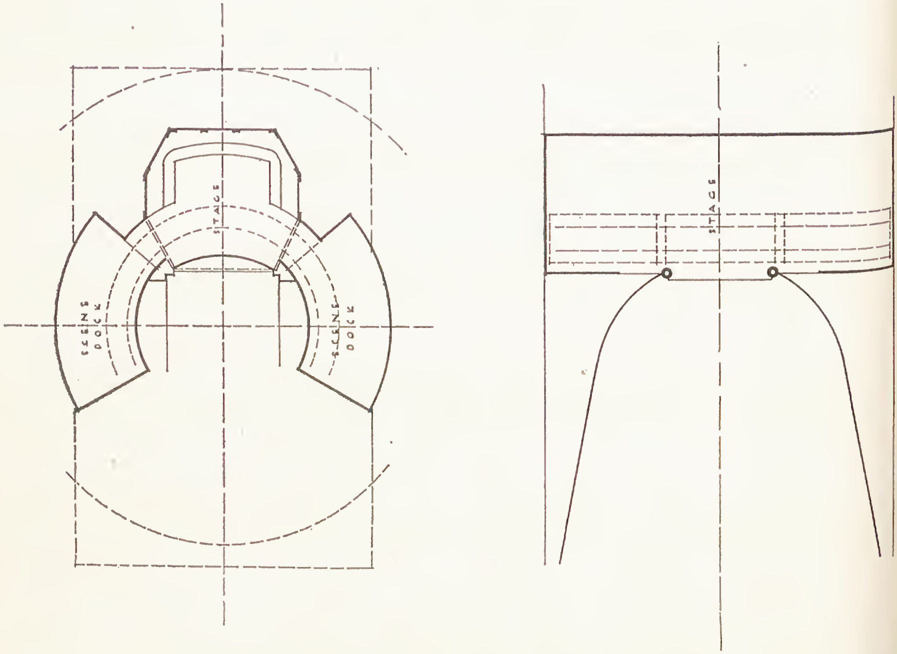


Fig. 7.—TWO COMPARATIVE METHODS OF PLANNING SLIDING STAGES FOR RAPID CHANGES OF SCENE

one. Seating spaced at less than 35 in. between each two rows sacrifices visibility and comfort for the sake of seating. If each row of seats is staggered the spectators can look between the heads of others in front of them. One should bear in mind that incline of auditorium plus space between seating determines visibility or how one row of spectators is able to see beyond those in front of them accordingly. Thus, staggered seating on an incline of 1 in. to 1 ft., spaced at 35 in., places the heads of one row of spectators $8\frac{3}{4}$ in. higher than the heads in direct line two rows away.

Balcony Seating

Balcony seating need not be staggered, as the height of the balcony rail or balustrade necessitates incline of tiered seating area to ensure a complete view of the stage. The ascent of each tier is determined by seating rows of spectators at such ascending levels that those in the back row may see the front edge of the stage over the balcony rail. Hence the consequently increasing and steep angles at which upper balconies and galleries are set in the older vintage of contemporary theatres.

Link between Stage and Auditorium

The auditorium and that part of the stage which is revealed to the audience need to be considered as inseparable structures, or unified so far

as circumstances permit. The first objective of such unification should be the erection of an architectural sound-box, in other words, a vehicle in which all spectators, no matter where they sit, can hear an actor whisper and at the same time clearly observe the dramatic significance of a whisper. This fundamental consideration, added to such means of public access and exit as will vomit an audience into the street, without crowding of gangways and other sources of panic and confusion, is the beginning of an ideal theatre. This objective entails an isolated building, a building on what is commonly termed an island site, a theatre which empties the audience into three streets at once.

Fig. 8.—NEW THEATRE, OXFORD—ENTRANCE

The stage of this theatre (see plan) has a 35-ft. revolving stage, cuts, traps, counterweighting gear for 63 sets of scenery, grid, scene dock, fireproof curtain, lighting bridge, etc. The dressing-rooms, provided with hot water and baths, give accommodation for 130 artistes, and are served by lifts capable of holding 14 artistes. (*Architects : W. & T. R. Milburn, FF.R.I.B.A.*)

Foyer and Cloakroom Accommodation

Such a theatre will provide for sociability as well as actual entertainment, by means of comfortable foyers for social intercourse and refreshment ; restaurant service is not inconceivable in the modern theatre as an amusement centre, and, amongst other amenities, adequate cloakrooms with easy access to and from the auditorium are highly important. In no respect are English theatres so put to shame by those on the Continent and

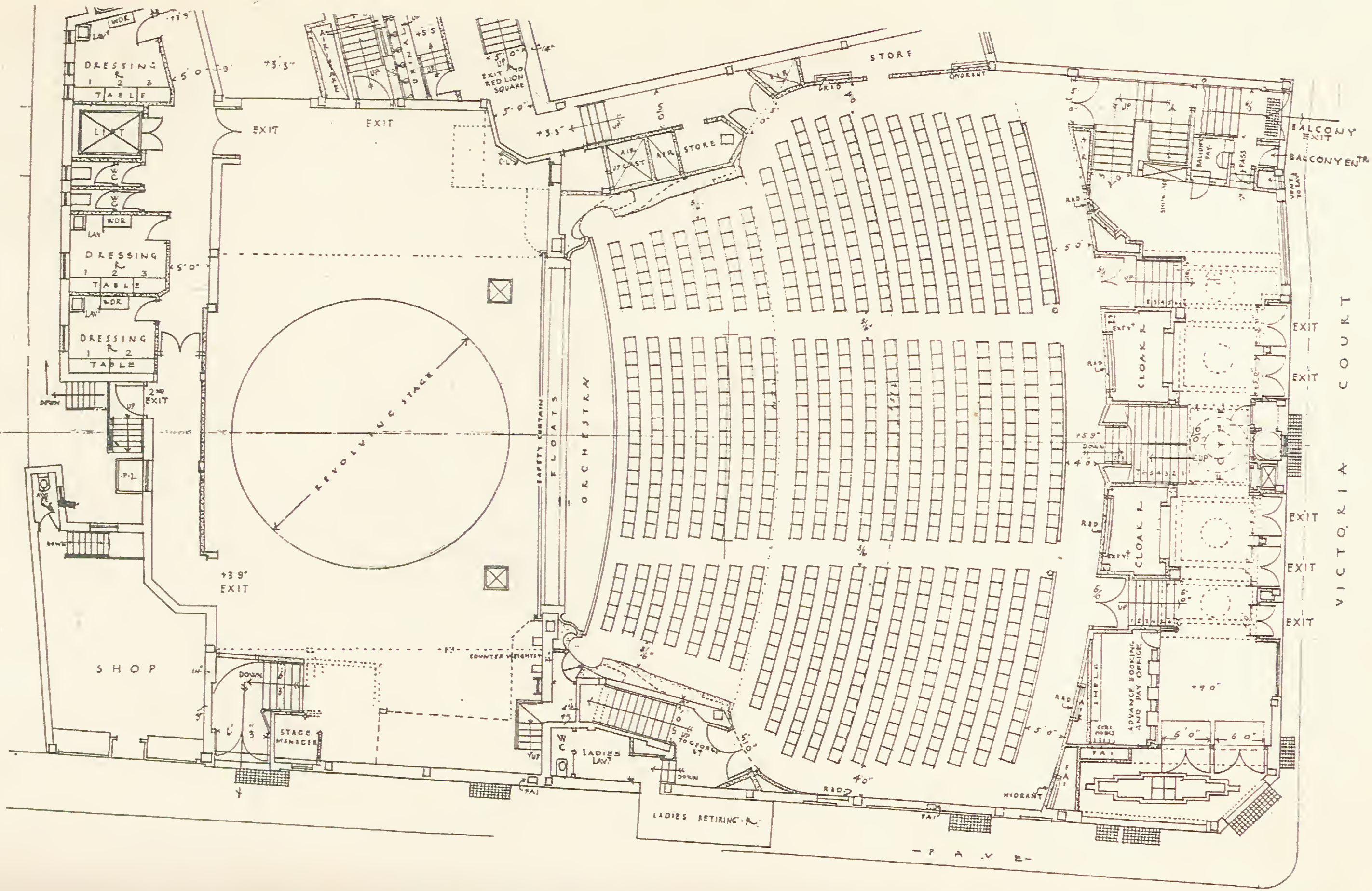


Fig. 9—NEW THEATRE, OXFORD—GROUND-FLOOR PLAN
Seating for 719 patrons. (*Architects* : W. & T. R. Milburn, F.F.R.I.B.A.)

in America as by the lack of cloakroom accommodation. Such convenience is more generously considered in cinemas, where, however, a continuous programme renders it somewhat abortive. Foyer and cloakroom accommodation should be proportionate to a theatre's seating capacity, but such essentials are not infrequently neglected for the sake of grand staircases, tiresome corridors, and other more or less decorative discomforts. Theatres have to be managed and therefore require managerial offices.

The relationship between stage and auditorium may be variable or invariable as the designer's conception of a theatre contrives. That relationship must be anticipated when designing the stage as a matter of geometrical visibility; let us say, the visible connection between stage and auditorium must be maintained by geometrical arrangement of sight lines. The ordinary public and, presumably, not a few theatre builders have been accustomed to think of the stage as what is revealed when the curtain rises; whereas, the inclusive requirements of a stage intended for anything in the nature of creative production demand much more spatial and mechanical organism than an audience sees. The stage is, therefore, the first cause of the theatre itself. The designer will consequently decide the potential and functional character of the stage, its projective relationship to an auditorium of whatever seating capacity may be desired, and so proceed with the plan of a complete theatre.

The Stage

The most complete theatre, however, can be not more than one amongst many others of which the different characteristics represent the theatre as a whole. Nevertheless, a theatre in which certain productions can in certain ways be well done is a reasonable proposition. Cinema designers have contributed nothing to stage design, and there is not one self-supporting theatre in English provincial cities, Stratford-on-Avon and Glydebourne aside, equipped for creative stage production.

Scene Shifting

An adequate stage decides not only the nature but also sets the tempo of what is seen by means that are unseen. Tempo in stage production is a decisive factor, so decisive that various systems of stage organism for quick change of scene have been devised at considerable expense in a few of the most important theatres of to-day. Such systems include revolving, sliding, and sinking stages, by which scenes are successively presented and replaced in mechanical rotation. Revolving stages are least successful, as they reduce the area of different settings which have to share the revolving platform at one and the same time, whilst imposing certain limitations on scenic design. Sliding platforms intended to transport complete scenes on and off the stage require more extensive stage area than is usually possible in suitable building areas, but are a sound

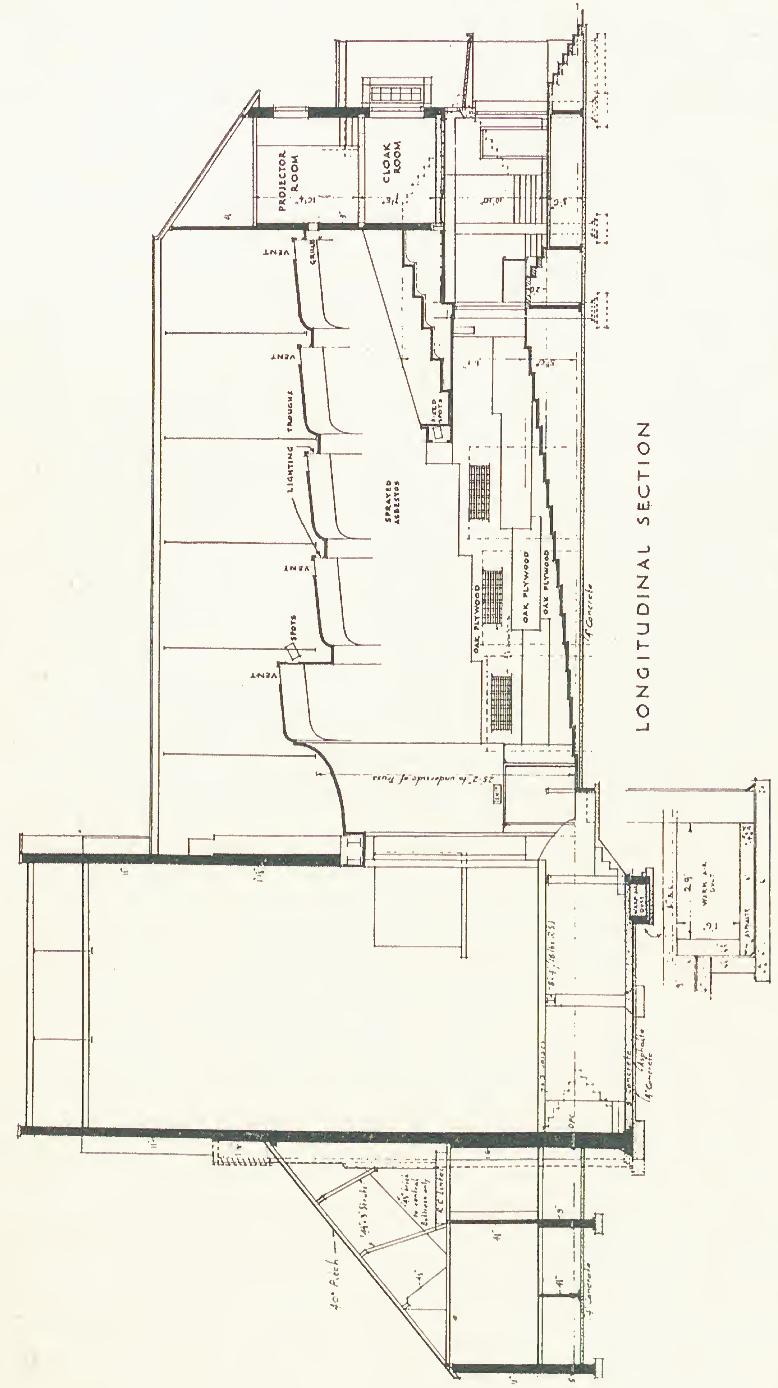


Fig. 10.—THE JOSEPH ROWNTREE MEMORIAL HALL

An excellent example of a building intended for amateur theatricals and other entertainment. Note that the theatre is fitted with modern air conditioning. See also plan, Fig. 11.

mechanical proposition where cost is no obstacle. Sinking stages, which would allow fairly quick succession of complete settings underground, in the cellar, so to speak, necessitate expensive construction and mechanical apparatus, besides inevitable complications when a number of scenes each require a number of different levels. The most useful and economical device for expediting the setting of scenes at different levels is the stage lift, operated in sectional formations by hydraulic or electrical power. Mechanical devices for changing scenes without intervals during performances are costly, if not beyond the means of ordinary theatrical enterprise.

The Use of Stage Lifts

The fact is, ordinary methods of scene-shifting would be far more efficient if all stages were equipped with lifts to save time wasted in shifting cumbersome platforms and rostrums generally employed to build up different stage levels, and also if every stage included requisite space for docking scenery and other material when such is not actually in use. Ordinary methods of doing things are too often abused without fair practice, and it is not unfashionable to advocate extravagant ideas as remedies for such abuse, especially in the theatre.

Adequate Scene Docks

It is beyond the scope of this article to discuss the theatre as a subsidised institution; on the other hand, self-supporting theatres must satisfy public demand, but, nowadays, that demand embraces more efficient stages than have survived the advent of the cinema screen, which, after all, is a potential instrument and not a substitute for the stage. Time means money on the stage as well as in other works, so a well-planned stage is, eventually, more economical, effective, and profitable, than one on which time and labour are wasted and effective production frustrated by lack of practical facilities. A practical stage will include adequate scene docks and workroom to accommodate scenery and other material when such is not actually displayed, isolated by fireproof doors or steel shutters. The superficial area of these adjunctive portions of the stage should be at least one-quarter of the working stage area; one-half the working stage must be out of sight behind the proscenium wall. Thus, a practical stage is about two and a half times the area revealed immediately behind the curtain.

Dressing-room Accommodation

Stage workers have exacting duties at unusual hours and, in the domain of spectacular production, need the following dressing-room accommodation: large chorus rooms for both sexes; ballet room; supers' room; rooms for two or three performers each; single rooms for principal performers; stage director's room; musical director's room; room for orchestral performers and instruments; wardrobe and sewing-

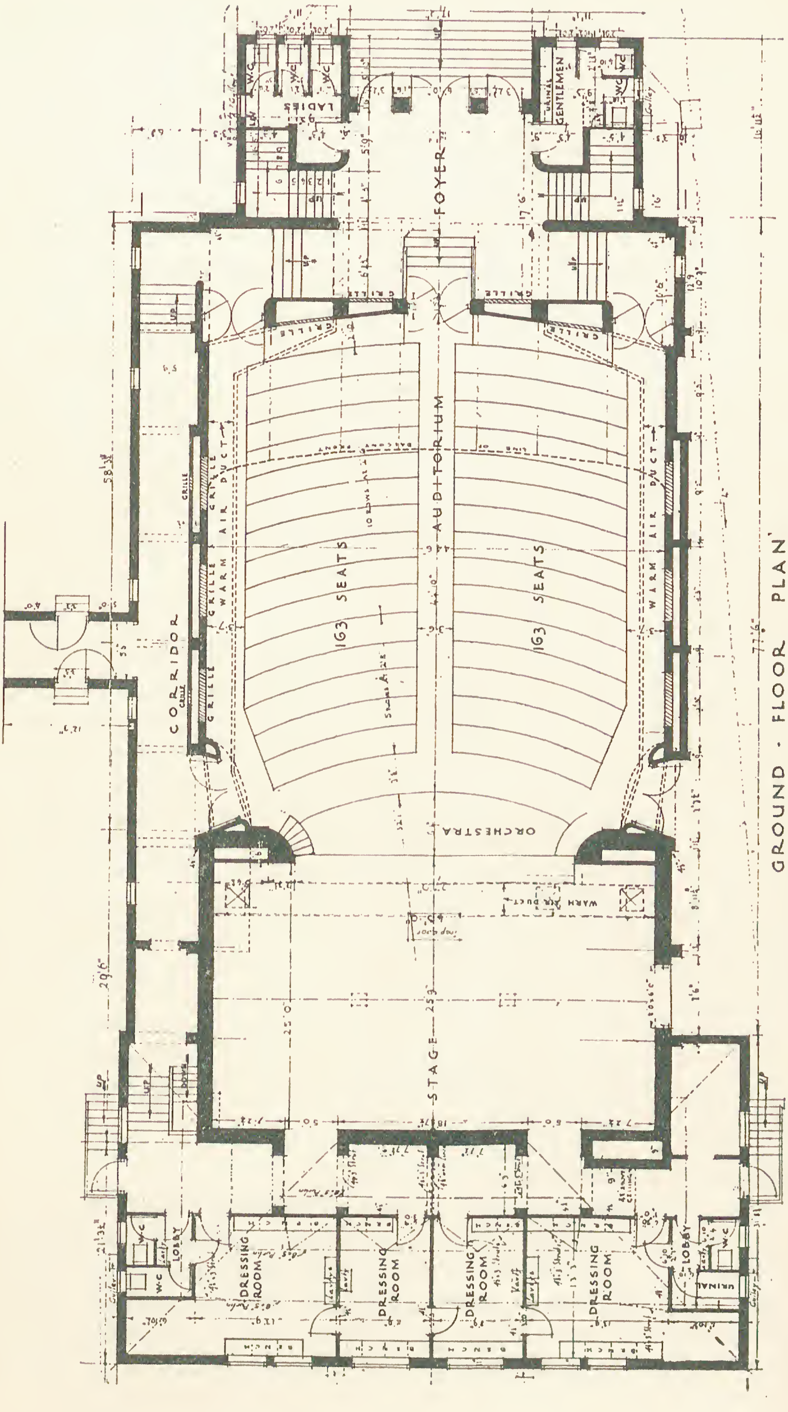


Fig. 11.—PLAN OF THE JOSEPH ROWNTREE MEMORIAL HALL
(*Architect: Barry Parker, F.R.I.B.A., P.P.T.P.I.*)

room. If dressing-rooms for male and female performers are separately situated, say on either side of the stage, so much the better.

Dressing-room Equipment

Dressing-rooms should be soundproof from the stage, and their equipment includes: wash basins with hot- and cold-water supply; hanging wardrobes, with drawer and rack for small apparel; efficient lighting unit and mirror over each "make-up" table; a full-length illuminated mirror. On each dressing-room floor, proportionate toilets and a shower bath are essential.

"Green Room"

If possible, a lounge or "green room," where performers can rest and associate, will encourage harmony and efficiency on the stage.

Staff Accommodation

Staff accommodation, within the radius of scene docks, should consist of separate workrooms for machinist, electrician, and property master, also a general staff cloakroom and lavatory.

Below Stage

Below stage is the region of machinery for stage lifts, ramps, and traps, boilers and other plant for heating, lighting, and ventilation. Under the forepart of the stage, opening into the auditorium, but below the auditorium floor level, may be the orchestra platform which, for grand opera, may have to accommodate from seventy to a hundred musicians.

The Gridiron

Above stage is the realm of a lofty framework and apparatus, necessary for hoisting and suspending scenery and electrical equipment, called the gridiron or rigging loft. The gridiron, preferably of steel, is rigged with sets of three or four sheaves each, equally spaced, and occurring at 7-in. centres parallel to the proscenium. Tackle passed through the sheaves is operated from fly galleries, or, advisably, by extension down side walls of the stage, can be operated from the stage itself. The gridiron must be no closer to the roof of the stage than will allow men to walk on it upright. There must be a skylight in the roof of the stage, conforming to fire regulations. Over a big stage, below the gridiron but above the fly galleries, a light steel catwalk may be suspended across the stage, halfway between the proscenium and back walls: connecting, similar, catwalks, under or in front of both fly galleries, are required for lighting and other purposes. Above the proscenium arch, preferably behind what may be termed an inner or false proscenium, should be a more substantial catwalk or bridge to carry special lighting equipment.

The Background

At the back of the stage there may be a false wall or screen ascending from stage level to gridiron, to be used as a permanent background for lighting and scenic effects. This screen will be wider than the proscenium opening, it may be curved at each end or not, and it may be coved at the top to reduce height and as a means of concealing its contiguity with the gridiron from the auditorium, instead of being flat and therefore more extensive for sight lines. Such a colourless background, by means of electrical equipment alone, reflects light that expresses hour, season, weather, and other effects that may be desired to illuminate and colour the scene as well as the actors, and to set material and human elements of the stage in relief. Alternatively, this background may consist of a movable screen made of canvas or other fabric, operated by mechanical apparatus, and commonly called a cyclorama. The construction of such a constant reflector of scenic illusion, sky, horizon, and other effects needs preconsideration, either as a permanent structure or in the form of mechanical equipment. The esential condition of this background is a surface that can be maintained in an unblemished state, and the choice lies between such building material as can be painted or faced with plaster, and less substantial fabric that can be rolled up on vertical cylinders when not in use. Sinking or sliding walls are not inconceivable as permanent backgrounds for the stage.

Conclusion

It is said that building regulations, mechanical services for heat, light, air conditioning, acoustical provisions, evolve a definite type of theatre. This convenient theory for imitators is a favourite assertion of many who reduce theatre designing to a dead formula, for purely commercial motives. Consulting engineers will readily show that heating requirements, 1,000 cu. ft. of conditioned air per hour per person, adequate lighting, distribution of sound with its original quality in requisite volume, do not account for either repetition or bad taste in theatre design. It might also be added that there are no regulations that result in tight planning and other sources of discomfort, which have so long characterised the theatre. Let no designer be alarmed by acoustics, because those who are really expert realise that good acoustical conditions are the result of as much experience as technical knowledge, and that sound absorption is not necessarily sound practice in itself, but is much overdone as a correction for bad planning and decoration in theatre design. Finally, a brief survey of the theatre, including some reference to its history, will show that theatre designers must, to some extent, be conversant with the problems of stage production as *raison d'être* of the theatre.

THE DEVELOPMENT OF PLANNING AND DESIGN

PART I.—PRE-GREEK ARCHITECTURE

THE study of the great buildings of the past is not only particularly interesting, but it is also extremely helpful to the modern designer or builder who wishes to take a broad view and to have a comprehensive grasp of his subject. This will be especially the case if the buildings of other ages are examined, not so much for their archæological interest or for their historical associations, but rather as examples of architectural planning and design. If in these buildings of earlier periods it is seen how other designers tackled various problems and solved them, the architect and builder will be helped in their approach to the problems which confront them at the present time.

EGYPTIAN ARCHITECTURE

If, for instance, some of the early buildings of the Egyptians are considered, they will in all probability first be found impressive because of the vast size of certain of the undertakings.

The Pyramids

The Great Pyramid at Gizeh, constructed about 3,700 years before the birth of Christ, is 760 ft. square and 482 ft. high. In order that these figures may convey a little more, they may be compared with the main dimensions of St. Paul's Cathedral. The latter building is 570 ft. long, and has an average width of about 150 ft., and thus covers an area about one-seventh that of the base of the Great Pyramid, while the height of the top of the cross over the dome of St. Paul's is but 360 ft., or about three-quarters the height of the pyramid.

Various theories have been evolved as to the methods by which the stones forming these pyramids were placed in position, one suggestion being that a sloping roadway was formed and gradually raised as the building of the pyramid advanced. The construction of such a road would, however, be almost a bigger task than the building of the pyramid, and the theory generally accepted nowadays is that the individual blocks were raised step by step by placing them on a "rocker"—an appliance something like an inverted centre for a segmental arch—and

levering the "rocker" over until the block of stone could be pushed on to the top of the course of masonry already built. But whatever the method adopted, the total amount of labour involved must have been colossal, being variously estimated at from 100,000 to 250,000 men working for thirty years.

The question is often raised as to whether we could put up such a structure at the present time. Undoubtedly the modern builder, with the appliances of to-day, would be able to carry out this work, and architects could doubtless be found who would be prepared to design such a building, prepare the necessary specifications and working drawings, and superintend the erection at the normal fees!

The Great Rock-cut Temple

Another very impressive work—though hardly a building—of the ancient Egyptians, is the great rock-cut temple at Abu-Simbel. This temple was cut out of the solid rock about 1300 B.C. The façade of this temple, formed in the shape of a pylon and adorned with four colossal seated figures representing Rameses II, is 119 ft. wide and over 100 ft. high, while each figure reaches a height of over 65 ft. To get some idea of the size of this façade, one may imagine that these figures are sitting on the roofs of good-sized houses, with their feet reaching to the middle of a broad road. Behind this façade are various chambers, ending in a sanctuary, and extending well over 100 ft. into the rock out of which they were hewn.

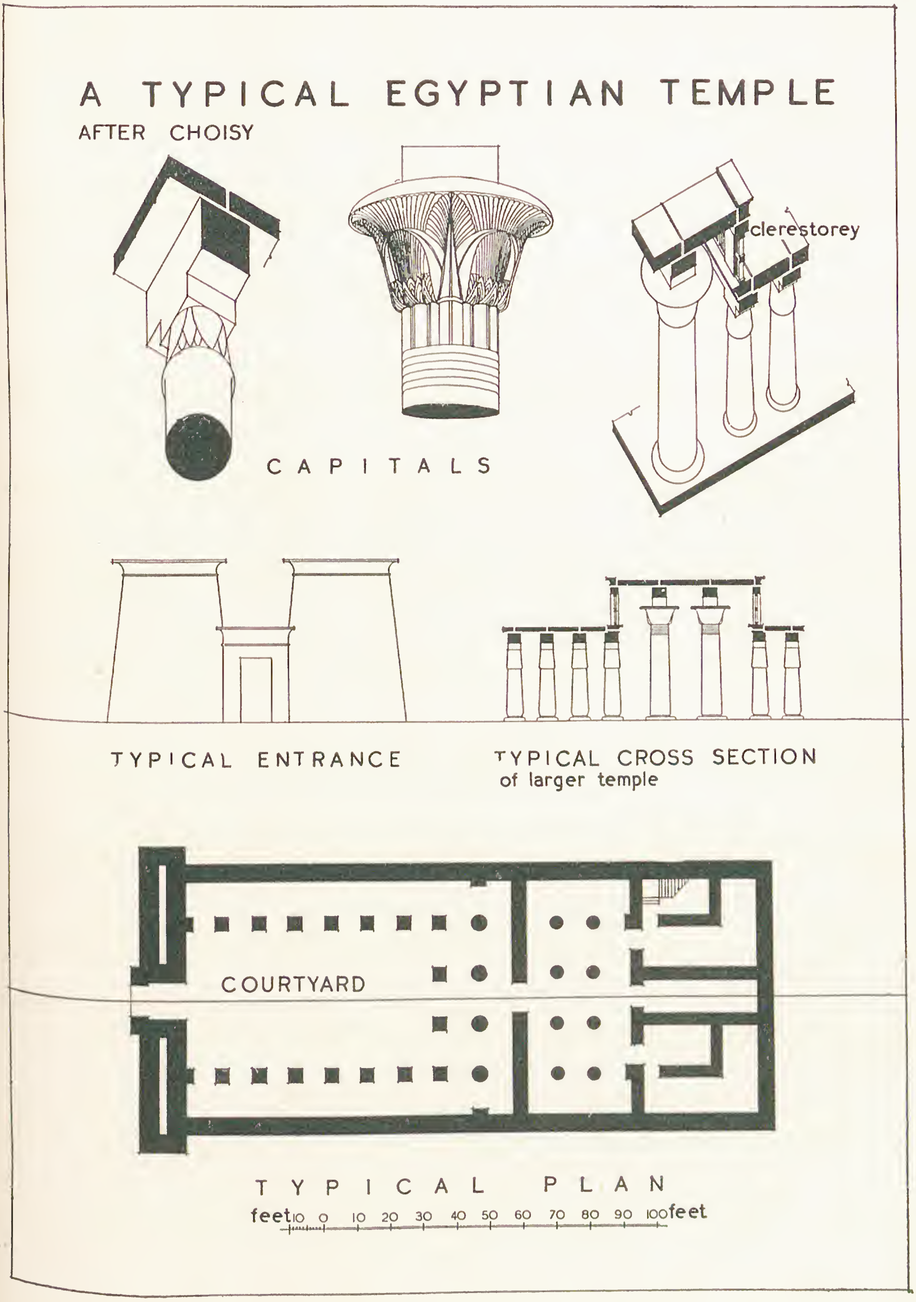
Functionalism in Egyptian Work

It is not, however, only size which impresses the beholder in these Egyptian works, for if the interior of the temple built about 3500 B.C. near the Sphinx is examined, in it will be found the germ of much later work, and even a striking suggestion of that functionalism of which so much is heard at the present day. The roof of this temple was supported by sixteen monolithic piers carrying massive stone lintels. These piers and lintels are of severely plain, rectangular section, unadorned by even the simplest architectural feature, and are essentially functional. They are used with the object of reducing the span of the whole building by dividing the area into what in later days would be called the nave and aisles, while there are also spaces more or less corresponding with transepts.

The Pyramids, the Sphinx, and the Sphinx Temple, to which reference has been made, belong to the Ancient Empire or Memphite Kingdom, extending approximately from 4500 B.C. to 3000 B.C.

Rock-cut Tombs

During the First Theban Empire, 3000 B.C. to 1700 B.C., some thirty-nine tombs were cut in the cliffs on the eastern side of the Nile at Beni-Hassan, with polygonal columns at the entrance which are sometimes


A TYPICAL EGYPTIAN TEMPLE
AFTER CHOISY
clerestorey
CAPITALS
TYPICAL ENTRANCE
TYPICAL CROSS SECTION
of larger temple
COURTYARD
TYPICAL PLAN
feet 10 0 10 20 30 40 50 60 70 80 90 100 feet

spoken of as proto-Doric, though it is very unlikely that they had any connection with the development of the Doric order in later days. Their polygonal form is probably due to the fact that while square supports would be very awkward in such a position, it would have been particularly difficult to work circular columns in the solid. Above these columns are carved projections which suggest the representation of the feet of rafters. These representations, like the panels carved on the façades of the Mastabas or private tombs of the Ancient Empire, were probably executed in imitation of an earlier timber construction.

In the interior of these rock-cut tombs are columns suggesting bundles of lotus stalks, tied at the necking under the bud-like capitals, which—like those of the outer columns—have a square abacus.

The ceilings of these tombs were cut in segmental form, possibly indicating a knowledge of the arch and vault, or, as the great French authority—M. Choisy—suggests, these ceilings may have been based on an earlier method of constructing timber ceilings with logs arranged in corbel fashion.

The Temple of Ammon at Karnak

The Second Theban Empire, extending from approximately 1700 B.C. to 1000 B.C., was the great temple-building period. It was during this Empire that the great rock-cut temple was formed at Abu-Simbel, and during this period the vast temple of Ammon was constructed at Karnak, covering an area of 1,215 ft. by 376 ft., or about six times the space covered by St. Paul's Cathedral. In front of this temple were pylons, 376 ft. across, 80 ft. thick, and 146 ft. high. Behind this façade, and approached by means of a central entrance, was a forecourt, the forerunner of the Roman atrium and the mediæval courtyard, and in some cases, though not in this, there was a second courtyard. Beyond the courtyard comes the hypostyle hall, and of such halls the example at Karnak is the finest.

The Hypostyle Hall

It will be seen that this hall, like others of the period, is divided into nave and aisles by means of columns, those at the centre being higher than those at the sides, thus allowing of a clerestory between the flat roofs of the aisles and that of the nave. The windows in this clerestory were formed by means of slits cut in the comparatively thin slabs of stone. This is a great advance on the Sphinx Temple —another stage towards the development of the later church—and a further advance may be seen in the treatment of the supports and lintels. In the earlier example these features were purely structural, being of simple, rectangular section throughout, but at Karnak the supports are of carefully shaped outline, circular in plan, and have their extremities emphasised by means of bases and capitals. Other Egyptian

columns are not plain circles in plan, but are indented somewhat similarly to those in the interior of the rock-cut tombs at Beni-Hassan, the lines of the reed-like shapes emphasising their verticality. Certain of the lintels at Karnak, and elsewhere in Egypt, are treated with the roll and gorge moulding, a form possibly derived from an earlier period in which walls were made of reeds and clay. This emphasis, thus given to certain important architectural elements, is of fundamental importance, marking the difference between utilitarian building, and architecture in which both utility and beauty must be considered.

Column-and-Lintel Method of Covering Spaces

At Karnak there are 134 columns in the main hall, the ten central ones being 12 ft. in diameter—about the same width as the piers of Peterborough Cathedral, while the height of the central space is 76 ft.—about the same as the total height of the nave at Peterborough.

This large number of closely spaced columns was necessary because of the fact that the length of the lintels spanning from column to column and from column to wall was limited by the size of the single stones used for that purpose.

The forms used for the capitals indicate a further important refinement, those used for the central columns being of open flower type, receiving light on their under sides from the clerestory openings ; while the lower columns to the aisles have capitals of bud form, more suitable for receiving light from above.

It may be mentioned here that the column-and-lintel method was the normal one adopted by the Egyptians for covering spaces. Arch forms were used, as in the case of the " vaulted " chambers in the temple of Seti I at Abydos, but these were not true arches, but corbelled stones cut into the shape of arches. Corbelling not cut to arch form was used to cover narrow spaces, as in certain passages in the pyramids, while sloping stones leaning against each other, forming a triangular-headed opening, were sometimes used for a similar purpose.

The Approach to the Temple

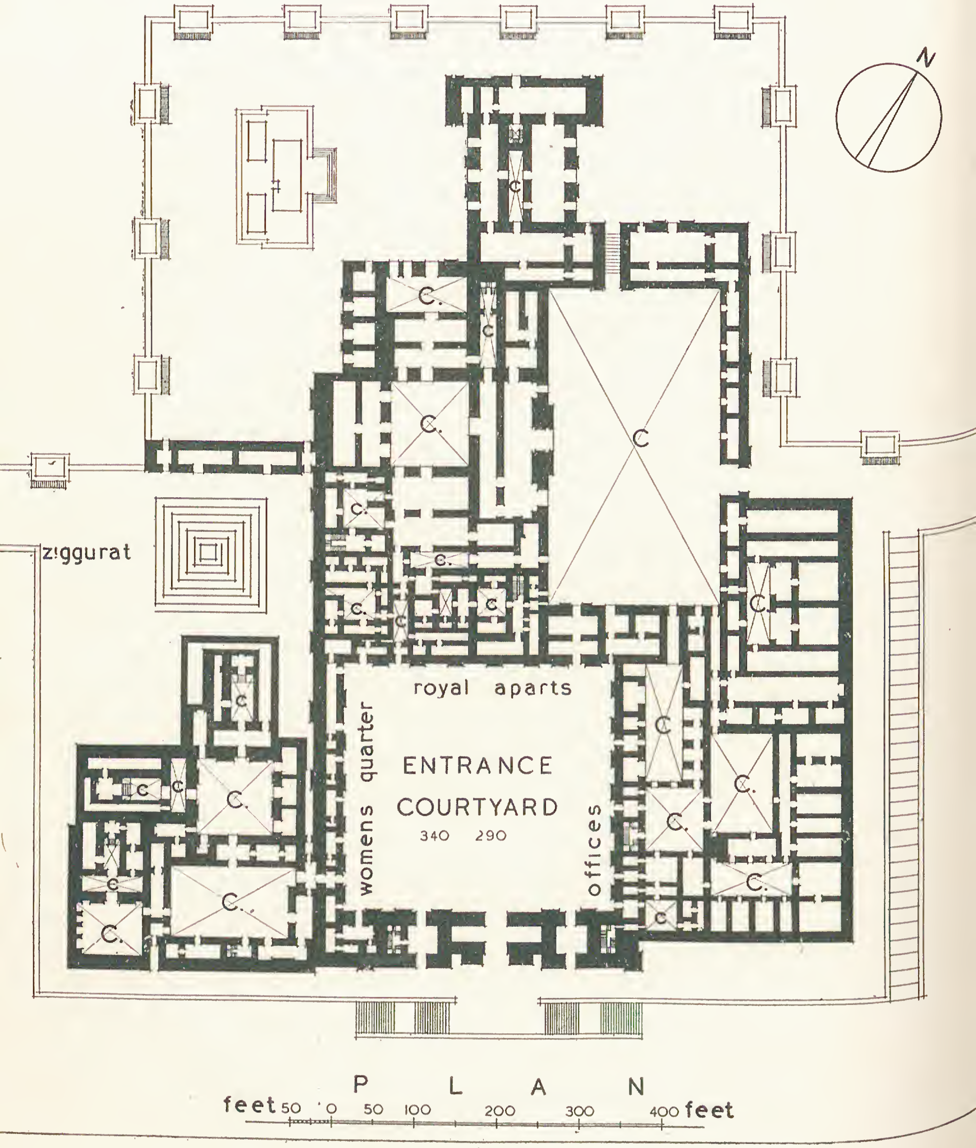
The hypostyle halls of the temples of the Second Theban Empire were open to members of the public, but beyond them were certain chambers and the sanctuary, open only to the kings and priests, and having little or no natural lighting. The whole scheme of the orderly planning of the temples is worthy of close study.

Monumental approaches were arranged to certain of the temples, and in the particular case of the temple of Ammon at Karnak there was a fine connecting road from the temple at Luxor, about $1\frac{1}{4}$ mile away, lined on each side with carved sphinxes, of which it is stated that there were probably about one thousand.

ASSYRIAN ARCHITECTURE

SARGON'S PALACE KHORSABAD

AFTER FERGUSSON



PLAN

These fine approaches, and the great pylons to which scale was given by means of obelisks, gave great external dignity, but it was essentially not a matter so much of giving beauty to the exterior of the temple as a whole, but rather of emphasising the importance of the entrance, the climax to the external procession, to be followed by the dramatic change from the dazzling light of the exterior to the varying degrees of gloom in the interior, all skilfully designed to give the most powerful effects of eternal mystery.

Egyptian Sculpture

While there are important examples of Egyptian sculpture in the round, such as the Great Sphinx, the Colossi of Memnon, and the figures of Osiris carved on the fronts of many piers, the bulk of the carving is in low relief, raised from the general surface in early work, and sunk below it in later. In many cases almost every available space is covered with such carving, often brightly coloured; in later work arranged in rectangular panels. Representations of human figures are arranged with the faces in profile, though the body is turned to the front.

Development of Egyptian Architecture

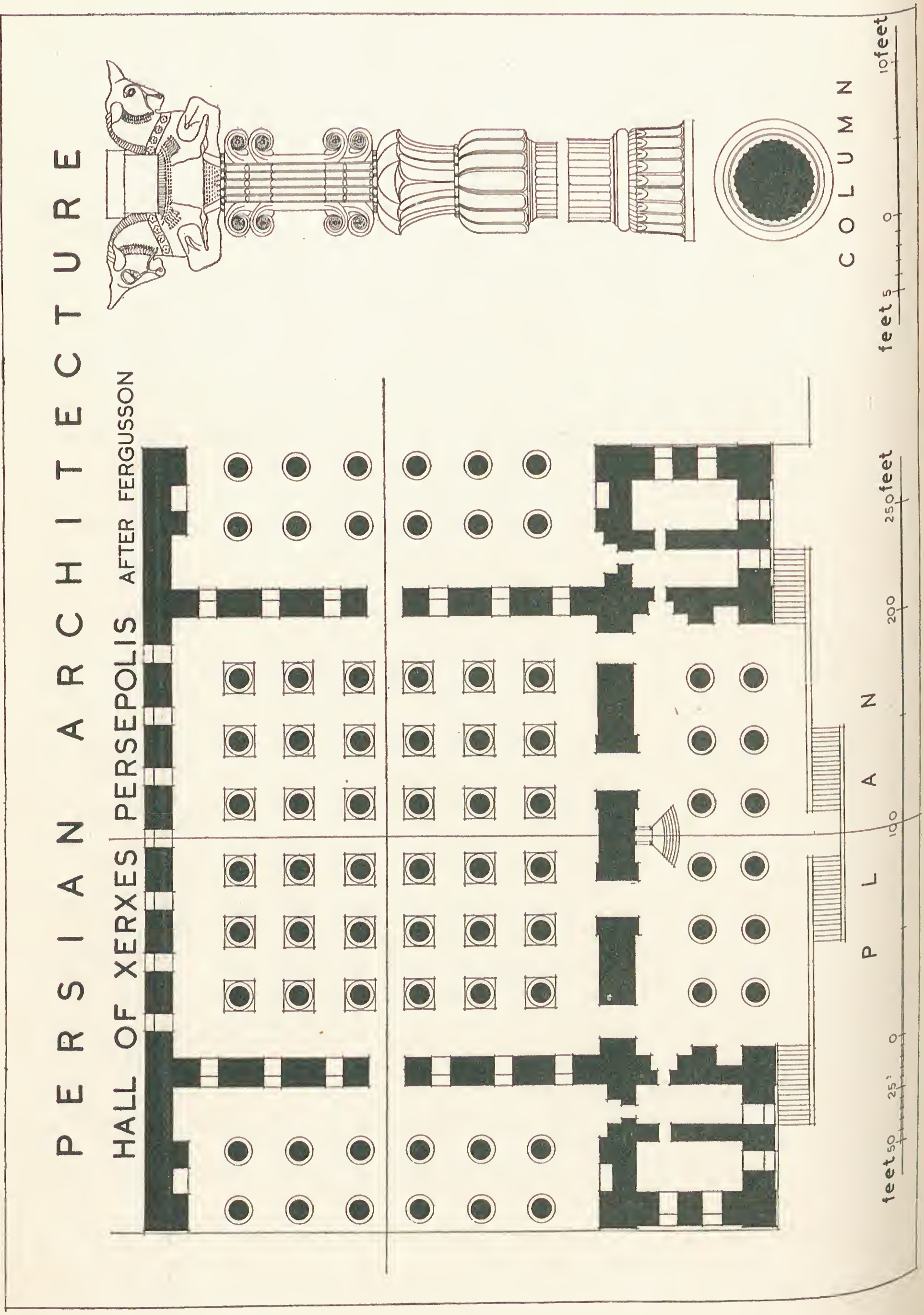
It has been pointed out by various writers—notably March Phillips—that after reaching a certain stage of development little further architectural progress was made in Egypt. Buildings of the time of the Second Theban Empire differ only in matters of detail from those of the Greek and Roman periods in Egypt, the most important development in the later work being the formation of openings in the roofs.

It may be noticed in other architectural periods, that there is at first steady advance in both design and technical skill; that a high standard is reached in design; and that further progress is then limited to technical efficiency, design either standing still or declining in standard.

In Egyptian art and architecture this seems to be most marked. March Phillips, in his *Works of Man*, goes fully into this matter. He points out that while the hand does well—"the practice of centuries in doing the same thing over and over again accounts for this, the mind, the guiding intelligence, is at fault, it refused to lead, and so for Egyptian art advance was impossible."

He asks why the Egyptian mind moved for so long in the same narrow round, and comes to the conclusion that this "naïve and childish simplicity is but a reflection of the simplicity of the natural conditions of the country."

It is interesting to note in connection with this continuity of Egyptian architecture, that during the period of Roman domination, whereas the Romans built in their own manner in all other parts of their great


PERSIAN ARCHITECTURE
HALL OF XERXES PERSEPOLIS AFTER FERGUSSON
COLUMN
feet 5 0 10 feet
PLAN
feet 50 25' 0 100 200 250 feet

empire, the Egyptian tradition was too strong for them, and, as has already been mentioned, the buildings erected at that time in Egypt differed only in matters of detail from the earlier structures.

ASSYRIAN ARCHITECTURE

Principal Materials Used—Bricks and Tiles

In the architecture of Assyria, between the years 1700 B.C. and 539 B.C., many striking differences from that of Egypt are to be seen. In the first place, the temples are of pyramidal form, the sanctuary at the top being reached by steps or inclined planes, and of these temples little evidence remains. The Assyrians were not tomb builders, and their principal structures were their palaces. Again, instead of the granite and stone of the Egyptians, the principal building materials were brick and tile, stone being used for sculpture and for facing the lower part of the walls. This change of material led to a change of construction, the long stone lintels of the Egyptians giving way in Assyrian architecture to arches and vaults formed of large numbers of smaller pieces of brick and tile.

Sargon's Palace

In the planning of such a structure as Sargon's Palace at Khorsabad (772 B.C.), considerable skill in that difficult art is exhibited. The building is of very considerable size, the great courtyard being 340 ft. by 240 ft., and having women's quarters to the left, various offices to the right, and the royal apartments directly opposite the entrance. While the planning is not strictly symmetrical throughout, it is so in parts, and it is of a type which gives considerable dignity to the scheme. The roofs were probably semicircular in shape internally, formed of brick vaulting, and flat on the top. As a result of the use of the arch and vault the walls were of considerable thickness in order to resist the thrust. The three main semicircular-arched entrances are flanked by carved representations of human-headed bulls, two legs being carved on the front and four at the side, a curious indication of the difficulty experienced in an early attempt at representation in sculpture.

Assyrian Ornament

While there are interesting remains of Assyrian ornament—notably the Assyrian stone threshold in the British Museum, showing the development of ornament from the Egyptian lotus toward the Greek egg and dart, and showing the influence of woven textiles with fringes on the forms of architectural ornament—there are no remains of columns, though there are Assyrian carvings representing columns with volutes and with leaves.

PERSIAN ARCHITECTURE

Persian architecture, 539 B.C. to 333 B.C., shows the influence of both Assyria and Egypt. At Persepolis, Darius erected a palace and a hall of a hundred columns between the years 521 B.C. and 485 B.C. The columns which remain are of very curious form, with bell-shaped bases, slender shafts with many flutes, and strange capitals formed with Ionic-like scrolls placed vertically and crowned with double bulls or double horses.

In the hypostyle hall built 485 B.C. by Xerxes, the thirty-six columns in the hall are about 67 ft. high, and only 5 ft. in diameter. In approximately the same area, in the great hall at Karnak, there were 134 columns, each about double the diameter of the Persian columns. This remarkable difference in the size and number of supports in about the same space is due to the fact that the Persian hall was covered with a timber roof, while the Egyptian roof was of stone.

In the Louvre are fine examples of coloured and glazed brickwork from the Persian palaces at Susa, showing a remarkably high standard of attainment in the use of that material.

PREHISTORIC GREEK ARCHITECTURE

At Knossos

In prehistoric Greek work of from about 3000 B.C. to 776 B.C. are many features of great interest. At Knossos, in Crete, the Royal Palace, of vast area, constructed about 2000 B.C., is over another palace of about 3000 B.C. Apartments in several storeys reached by staircases are arranged round the courtyard in this palace, the apartments being adorned by wall frescoes and coloured plaster ceilings. Porticoes were arranged with columns between pilasters—early examples of the "portico *in antis*" of later days in Greece—while drainage schemes were devised with terra-cotta drain pipes, amazingly complete considering the early date.

At Tiryns

At Tiryns, the remains are of outstanding importance, as they show clearly the plan of an early palace, the basic idea of which appears to have been the careful segregation of the men from the women, each having their separate apartments, courtyard, and approach, the planning being both orderly and ingenious (see page 340).

Gateway of Lions

The famous Gateway of Lions at Mycenæ is important for two reasons: first, for the typical corbelled opening of triangular form over the massive lintel supported by two stalwart uprights; and, secondly, for the sculptured slab in the triangular space, on which are represented

two lions, one on each side of a column which tapers downwards, this apparently being the normal form of column in prehistoric Greek architecture. The placing of this sculpture in a space where it is protected and relieved of pressure is also very noteworthy.

Tomb of Agamemnon

At Mycenæ there is also the Tomb, Treasury, or Tholus of Atreus or Tomb of Agamemnon, as it is variously called. This is a circular structure about 50 ft. internal diameter, built in domical form, not as a true dome, but by means of corbelling. Tombs of this type were covered with a mound of earth, and are commonly referred to as "beehive tombs." The entrance to the one at Mycenæ is somewhat similar to the Gateway of Lions, being spanned by a huge lintel, above which is the normal triangular opening, which was no doubt originally filled with sculpture. The opening below the lintel is, like later Greek openings, wider at the bottom than at the top, and at each side it had a delicately carved half-column, tapering downward to a slight degree. Some idea of the scale of this structure may be gained from the facts that one of the lintel stones is 29 ft. 6 in. long, 16 ft. 6 in. wide, 3 ft. 4 in. high, and that its weight is about 100 tons.

EARLY TOWN PLANNING

In studying the works of the builders of the past it is advisable not to limit investigation to the design of the single building, but also to note to what extent skill is shown in the grouping of buildings, in the layout of towns, and in the art of giving special dignity to certain portions of that layout.

In Egypt

In Egypt, for instance, about 2500 B.C., workmen engaged on the building of one of the pyramids were housed in Kahun, a town which was laid out with a considerable degree of orderliness and efficiency, though no doubt lacking in the higher qualities of town planning. In *Towns and Town Planning, Ancient and Modern*, by Hughes and Lamborn, the authors state that "though Kahun was more sanitary than some of our own neglected slums, it was probably as uninspiring as our workhouses, barracks, and public elementary schools."

On the other hand, very considerable dignity was given to certain of the temples of ancient Egypt by means of the processional ways to which reference has already been made.

In Babylon

In ancient Babylon, also, it is clear that great importance was attached to the general layout of the city, the arrangement of a great processional

way, the disposition of a triumphal arch, and the provision of subsidiary streets intersecting the main street at right angles.

THE INFLUENCE OF A HOT AND DRY CLIMATE

The climate of Egypt is hot and dry, a condition which allows of the construction of a comparatively simple type of building, for while it was necessary to provide protection against heat, the protection of the buildings from the effect of wet weather was not so necessary, and that is a somewhat more difficult task. The question of lighting was also a simple one in ancient Egypt. The principal effect of such a climate is that it normally results in the use of a flat roof; a sloping roof, by means of which rain-water is conveyed from the building, not being necessary, could not have occurred to the builders. To obtain light in such a climate it is only necessary to make openings, and these need not be very large even to get a well-illuminated interior, while it is probably natural that in a hot climate, with a brilliant sun, a dim light would be preferred—the inhabitants would, in fact, go into a building to get away from the heat and bright light outside. In sunny lands, artists and decorators seem to use bright colours naturally—possibly partly because such colours are prevalent in nature in such countries; and so vividly painted ornament was usual in Egyptian work, together with carvings in delicate reliefs which are only suitable in a clear, sunny atmosphere.

With regard to the siting of Egyptian buildings with reference to their surroundings, there was not much choice. The temples were usually built on the flat land near the Nile, while many of the tombs were cut in the face of the cliff, but it is very interesting to note that the general form taken by the buildings fits in admirably with the landscape.

LIST OF REFERENCE BOOKS

Readers who wish to make a further study of the subjects discussed above are advised to consult the following volumes:—

Sir Banister Fletcher: *A History of Architecture on the Comparative Method.*
F. M. Simpson: *History of Architectural Development*, Vol. I.
A. Choisy: *L'Art de bâtir chez les Egyptiens.*
W. Worringer: *Egyptian Art.*
March Phillips: *The Works of Man.*
Perrot and Chipiez: *Histoire de l'art dans l'antiquité.*
Sir Arthur Evans: *The Palace of Minos at Knossos.*
Anderson, Spiers, and Dinsmoor: *Architecture of Ancient Greece.*
M. and C. H. B. Quennell: *Everyday Things in Homeric Greece.*
F. Haverfield: *Ancient Town Planning.*
Hughes and Lamborn: *Towns and Town Planning.*
Atkinson and Bagenal: *Theory and Elements of Architecture*, Vol. I.

PART II.—GREEK ARCHITECTURE

DURING the main period of Greek architecture, which is usually stated to have extended from 776 B.C. to 146 B.C., a remarkable development took place, culminating in buildings which have set a standard for all time.

In giving these dates it should be made clear that the architecture of the past cannot be divided into a series of watertight compartments, and while approximate dates are convenient, it must be remembered that there was much overlapping, and that in architecture change and development were constantly taking place. Compared with the slow and stately progress of Egyptian architecture over many centuries, Greek architecture moved steadily and decisively towards its climax.

The Greek Method of Construction

The Greek method of construction—wall, column, and lintel of stone or marble, and roof of timber—was simple and uncomplicated, as also were the plans of the buildings. The builders set themselves no great building difficulties to solve, such as those met with in the construction

Fig. 1.—THE PARTHENON, ATHENS, AS IT IS TO-DAY

This is generally agreed to be the greatest building of all time. It consists of two apartments, two porticoes, and a surrounding colonnade of eight at each end and seventeen on each flank.

Fig. 2.—THE PARTHENON, ATHENS

A closer view of the end columns. Note that this is an example of the Doric order of columns and lintels.

of vaults and domes, nor did they strive after the designing of buildings involving the complications arising from the use of many inter-related apartments ; but accepting a long-established type of construction, and plans of outstanding simplicity, they strove toward absolute perfection within those limits.

The Parthenon

While the unity of the design as a whole was the main object of the great effort which they made, no item was considered unimportant, but to the smallest detail every part was studied with the utmost care so as to ensure that it would contribute its proper share to the whole.

A first glance at the Parthenon—erected on the Acropolis at Athens between the years 454 B.C. and 438 B.C., and generally agreed to be the greatest building of all time—reveals a comparatively simple structure, consisting of two apartments, two porticoes, and a surrounding colonnade, the temple being octastyle peripteral, as will be explained later. The main apartment, which housed the statue of Athena, was divided into

Fig. 3.—The Temple of Nike Apteros, Athens

nave and aisles by two rows of columns, while the smaller apartment had four columns in its interior. It should be noted that the columns in the back row of each portico are not centrally behind those in the front row. The dimensions of the Parthenon—about 225 ft. by 100 ft.—are comparatively modest, the total area being but little more than one-third that of the hypostyle hall of the Temple of Ammon at Karnak, while the height of the external columns of the Parthenon is rather less than half that of the central columns at Karnak. In outline the external form is particularly simple—a rectangular prism covered by a triangular prism.

Overcoming Optical Illusions

The plan form, simple as it is, is one which had been gradually developed and improved; the scheme of columns and lintels had gone through a refining process steadily applied during some three hundred years, while still closer study reveals the astounding fact that a series of optical illusions has been carefully counteracted by skilful modification of line and dimension. Columns seen against the sky appear slightly more slender than the others—the angle columns of the Parthenon were

therefore made about $1\frac{1}{2}$ in. greater in diameter than the others. Vertical columns would appear to lean outward—so all the external columns of the Parthenon lean slightly inward, the amount of the inclination being so slight that the axes of the columns if prolonged would meet at a point about a mile above the building.

The sloping lines of the column shafts would appear to bend inward if they were perfectly straight—they are therefore made to bend slightly outward, the extent of the departure from the straight being at its maximum at a point two-fifths up the column, and at that point being approximately $\frac{2}{3}$ in. This curvature of the lines of the shafts of the columns is known as the "entasis."

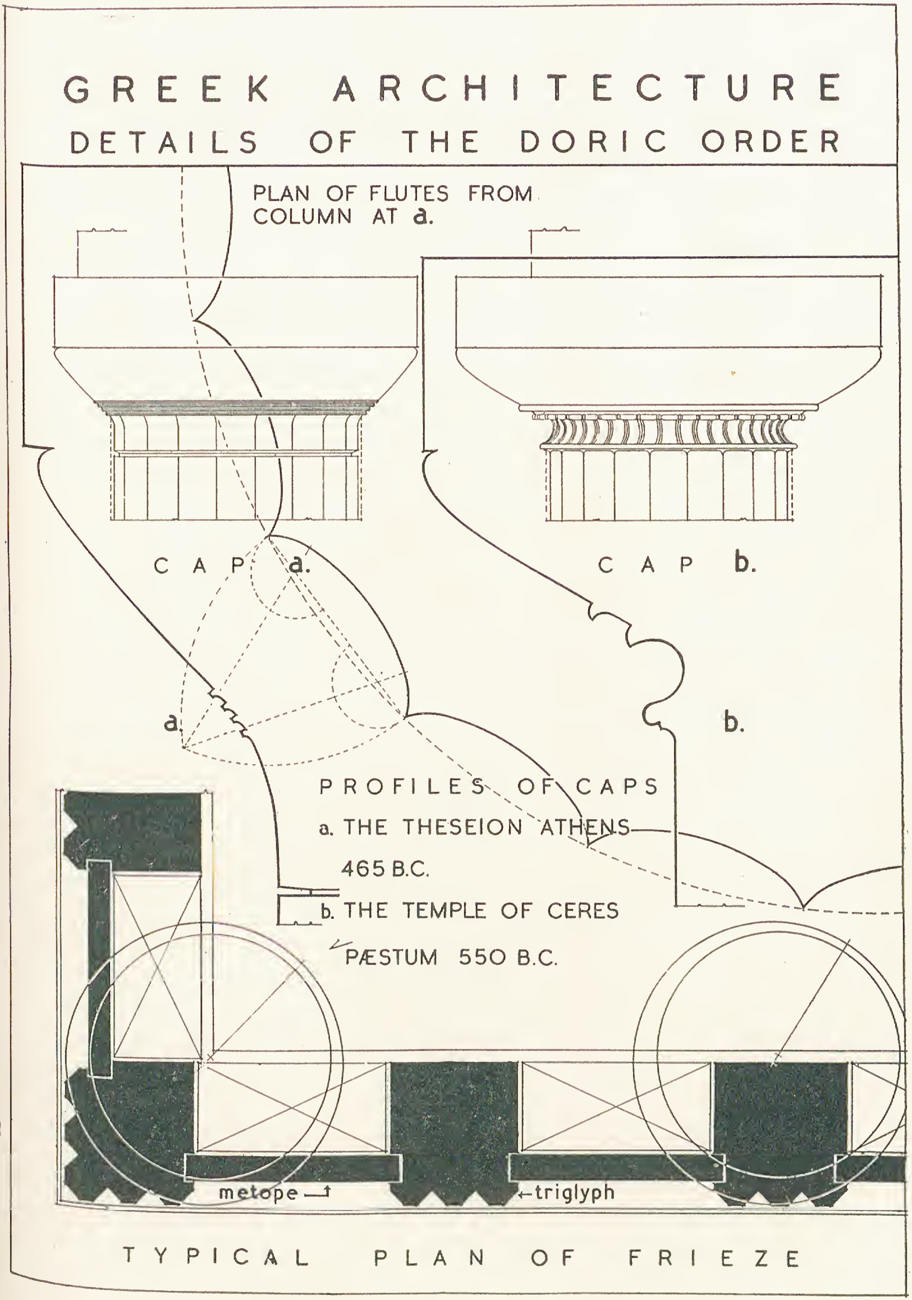
The horizontal lines of steps and lintels would appear to sag downward if made perfectly horizontal, and were therefore made to curve upward, the top step at each end of the Parthenon rising about $2\frac{1}{2}$ in. in its centre. For a similar reason the sloping sides of the pediment were slightly curved in an outward direction. Refinements of this kind, in which the lines of a building are made curved, not with the object of looking curved, but in order that they would look straight, are not matters which may be dismissed as impractical, for the study of such things is of definite value at the present time, when these ways of overcoming optical illusions, discovered by the Greeks over two thousand years ago, are still applied.

Development of the Plan

The simplest type of plan is the plain rectangular apartment with an entrance. This was developed in the prehistoric Greek period by placing two columns in the opening, and by designing the ends of the walls at the opening as pilasters or antæ, giving a plan type known as "distyle *in antis*." It should be mentioned here that, whereas in Roman and Renaissance work the pilaster capital was based on that of the column, in Greek architecture the anta capital is quite different from that of the column, and that in both Greek and Roman times the pilaster is parallel sided, diminution being given to pilasters in the Renaissance.

A further development of the plan was that of placing a row of columns projecting in front of the building—an arrangement known as "prostyle." If a similar row of columns was placed at the rear, the scheme is known as "amphi-prostyle," the number of columns at each end being indicated by the terms "tetrastyle," "hexastyle," etc., the temple of Nike Apteros on the Acropolis at Athens being an example of an "amphi-prostyle, tetrastyle" temple.

The type of temple in which a colonnade is arranged on all the four sides is known as "peripteral," the Theseion at Athens being a hexastyle, peripteral example, and the Parthenon octastyle peripteral. Temples in which a double colonnade was placed on all four sides are "dipteral," the later temple of Diana at Ephesus being a dipteral


GREEK ARCHITECTURE
DETAILS OF THE DORIC ORDER
PLAN OF FLUTES FROM COLUMN AT a.
CAP a.
CAP b.
a.
b.
PROFILES OF CAPS
a. THE THESEION ATHENS 465 B.C.
b. THE TEMPLE OF CERES PÆSTUM 550 B.C.
metope
triglyph
TYPICAL PLAN OF FRIEZE

octastyle example. If a temple is arranged so as to have the general appearance of a dipteral temple, but omitting the inner row of columns, it is known as "pseudo-dipteral," an example being Temple T or "G" at Selinus. In rare cases in Greek architecture, temples were arranged as "pseudo-peripteral," having instead of a single colonnade a range of half-columns attached to the wall of the building, a method of design common in Roman and Renaissance work.

Greek Temples

In Greek temples the columns are normally arranged with an even number, four, six, or eight, at each end, the Basilica at Paestum being a rare exception, having nine columns at each end. There was normally an odd number of columns on each flank, usually one more than twice the number at the ends. Thus, in the case of the Parthenon, there are eight columns at each end, and seventeen on each flank. An exception to this general rule is the Heraion at Olympia, a temple with six columns at each end, and sixteen on each flank. An even number of columns at each end, and an odd number on each flank, give the best results æsthetically.

In the case of comparatively narrow temples there were no internal columns, but in many cases, in order to reduce the span of the roof, it was necessary to divide the interior into "nave" and "aisles" by means of two rows of columns; special cases are the Temple of Apollo at Bassae, in which, instead of detached columns, there is a series of half-columns at the ends of short walls projecting into the "cella"; and the temple known as the Basilica at Paestum, in which there is a single row of columns down the centre.

In the normal temple, with the double row of internal columns, these columns were in two tiers—the same "order" or type of column being used in each case. In practically every example the upper columns have been displaced, but in the Temple of Neptune at Paestum some of the columns are still in position in the upper row.

In most cases Greek temples were arranged with their long axes east and west, the entrance being so arranged in the eastern end that when the doors were open the morning sun would illuminate the statue. A special case is that of the Temple of Apollo at Bassae, in which the long axis is almost north and south, but here a further opening was arranged in the eastern side, and the statue was placed opposite to it.

Methods of Lighting

There has been much discussion as to the method adopted by the Greeks in introducing light into their temples. One suggestion with regard to the Parthenon is that a clerestory was arranged over the double tier of columns in the interior; another that there was an opening in the roof. It is possible, however, that the only light admitted was

that obtained by opening the entrance door and that from the fanlight over.

The rectangular plans so far discussed were all symmetrical about a longitudinal axis. There is, however, one example of a Greek building with an irregular plan, namely, the Erectheum ; a number of circular structures, such as the Tholos at Epidauros and the Monument of Lysicrates ; and a polygonal building, the Tower of the Winds. Further particulars will be given of all these examples.

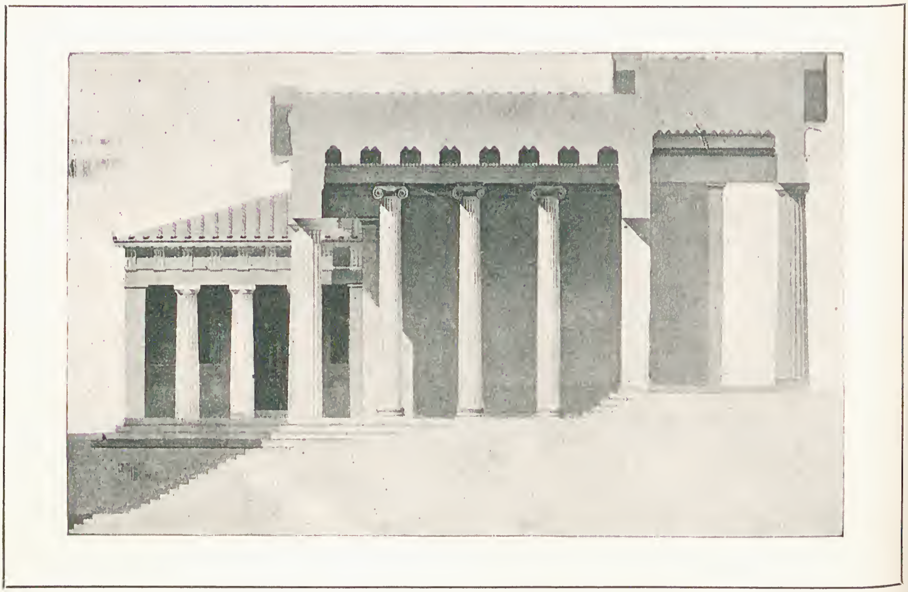
The Three Orders

In Greek architecture there were three main types or " orders " of columns and lintels : the Doric, the Ionic, and the Corinthian, the Parthenon being an example in which the Doric order is used. The essential features of the Greek Doric order are a sturdy, circular, fluted shaft with a capital but no base, the normal capital having a square slab as an abacus above a convex moulding, circular in plan, below which is a series of annulets.

Examples of Greek Doric Buildings

In the Parthenon and other Greek Doric buildings of the best period there are twenty arris flutes, some earlier examples having fewer or more. The shafts in some examples are unfluted, but in all probability this is owing to the fact that these buildings were not completed. With twenty flutes there is a flute in the centre of each face, and an arris below each angle of the abacus. The flutes, like the carving on Egyptian columns, help to indicate the circularity of the shafts, but unlike that carving they also emphasise their verticality and their function as supports. Reference has already been made to the entasis of the shafts, and to the fact that the columns lean slightly inward.

Resting on the columns is the entablature, the lowest member, the architrave, being formed of from one to three stones spanning from the centre of one column to the centre of the next. On the top edge of the architrave is a small projecting band, and below each " triglyph " of the frieze is a second band, with a set of small circular projections beneath it. The architrave is normally quite plain, but in the Naples Museum there is an early example of a carved architrave. Above the architrave comes the frieze, consisting of the triglyphs—massive blocks which support the superstructure, and project slightly in front of the " metopes "—approximately square, thin slabs, often sculptured, which come between the triglyphs. The latter are so called because on the face of each there are two grooves and a corresponding half-groove on each edge. One triglyph was placed over each column and another over the centre of the space between each two columns, this arrangement settling the spacing of the columns. There is an exception to this arrangement at each corner, where, instead of the triglyph being placed over the



SECTION OF THE PROPYLÆA AT ATHENS
(Restored by Ulmann)

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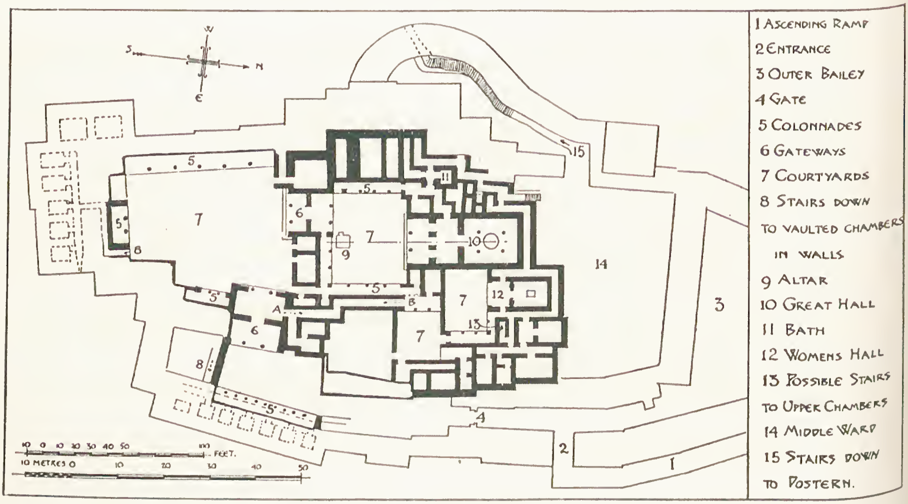

GENERAL PLAN OF THE CITY OF TIRYNS—AN EXAMPLE OF PREHISTORIC GREEK ARCHITECTURE AS REFERRED TO ON PAGE 330

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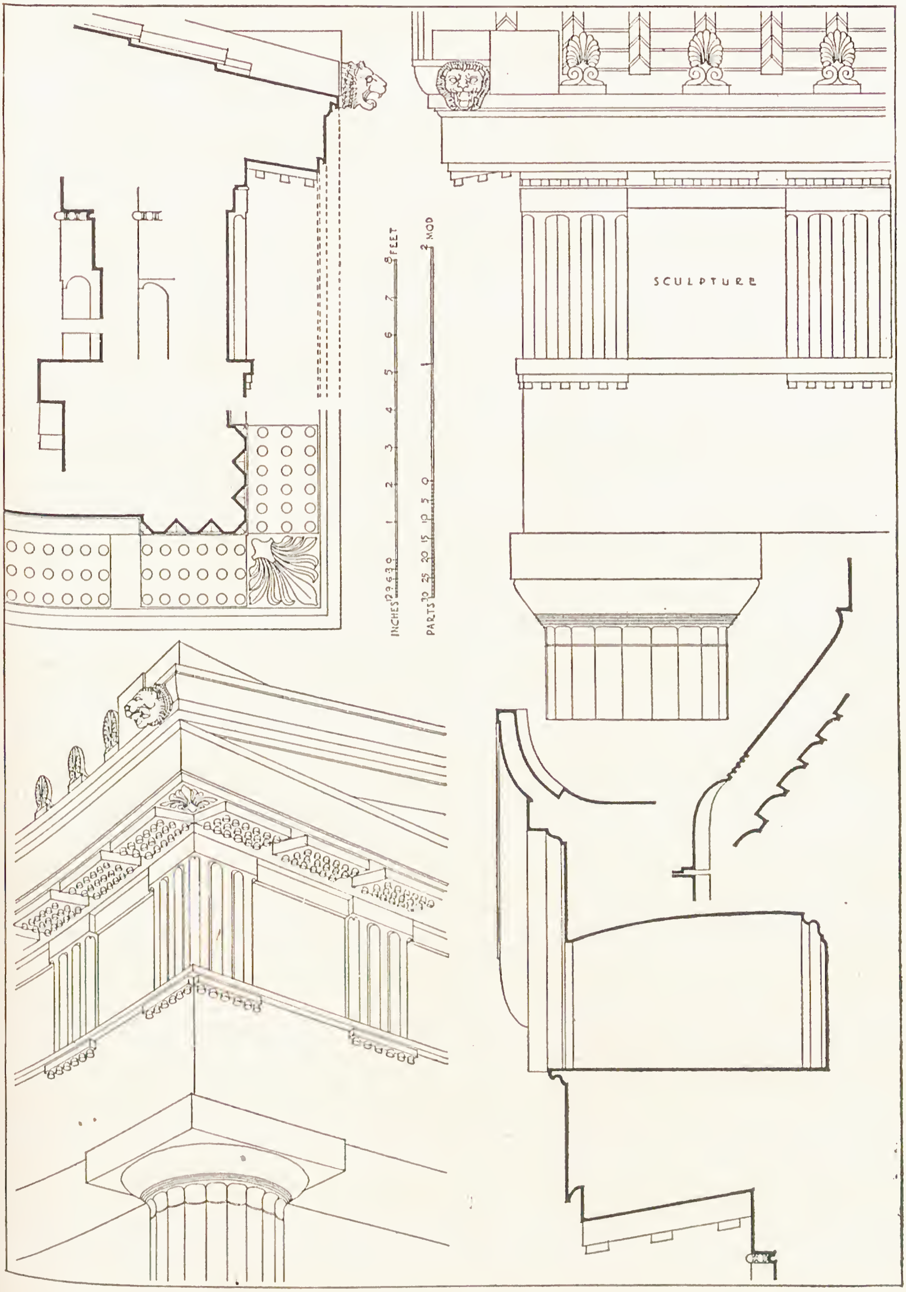

THE GREEK DORIC ORDER OF THE PARTHENON, ATHENS

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centre of the column, it is placed at the extremity of the frieze. As the metopes are normally all the same size, this results in the angle columns being closer together, which has a great advantage in giving an appearance of greater strength—where it is especially required—at the angles of the building. In the Temple of Ceres at Paestum the angle columns are the same distance apart as the others. This led to the belief that in this building the angle triglyphs were centrally over the angle columns—a theory which was abandoned on the discovery of some wider triglyphs. Above the frieze is the cornice, projecting boldly forward and having on its under side projecting slabs known as "mutules," each mutule having a series of circular projections or "guttæ" on its under side or soffit. There is normally one mutule over each triglyph and one over each metope. At each end of the temple is a pediment, the sloping cornice of which is of different section from that of the horizontal cornice.

In special cases, such as the central opening to the entrance to the Acropolis at Athens, where a wider space is required, two triglyphs instead of one are placed over the space between the columns.

Early Examples of the Greek Doric Order

Early examples of the Greek Doric order usually have very sturdy columns, those of the Temple of Athena at Corinth being about $4\frac{1}{3}$ diameters in height. This ratio was gradually increased until, in the best examples, such as the Theseion and the Parthenon, it is about $5\frac{1}{2}$. The early columns usually had an exaggerated entasis, but in some cases had none; the moulding under the abacus in early examples was a somewhat clumsily bulging curve, which was steadily refined in later examples until the subtle form used in the Parthenon was reached. There was similar development in sculpture, which reached a remarkably high standard in the Parthenon. Here there were three types: that of the pediments in the round; the metope sculpture, in which the figures are in almost complete relief; and the great frieze running round the walls of the building under the ceiling of the colonnade. This frieze is in low relief, averaging about $1\frac{1}{2}$ in. projection, but is deeper at the top and less deep at the bottom, so as to suit its position. It should be especially noted that all this sculpture is so placed that it is well protected, also that the sculpture on the metopes and in the pediments is not on structural parts.

Examples of Ionic Buildings

The Erechtheum, which was built about 400 B.C. to the north of the Parthenon on the Acropolis at Athens, is a fine example of the Ionic order. It has no colonnade, but there are two Ionic porticoes—the northern one a tetrastyle example projecting two intercolumniations, and the eastern one hexastyle and projecting only one intercolumniation, and with a much closer column spacing. There is also the well-known

THE ERECHTHEUM, ATHENS

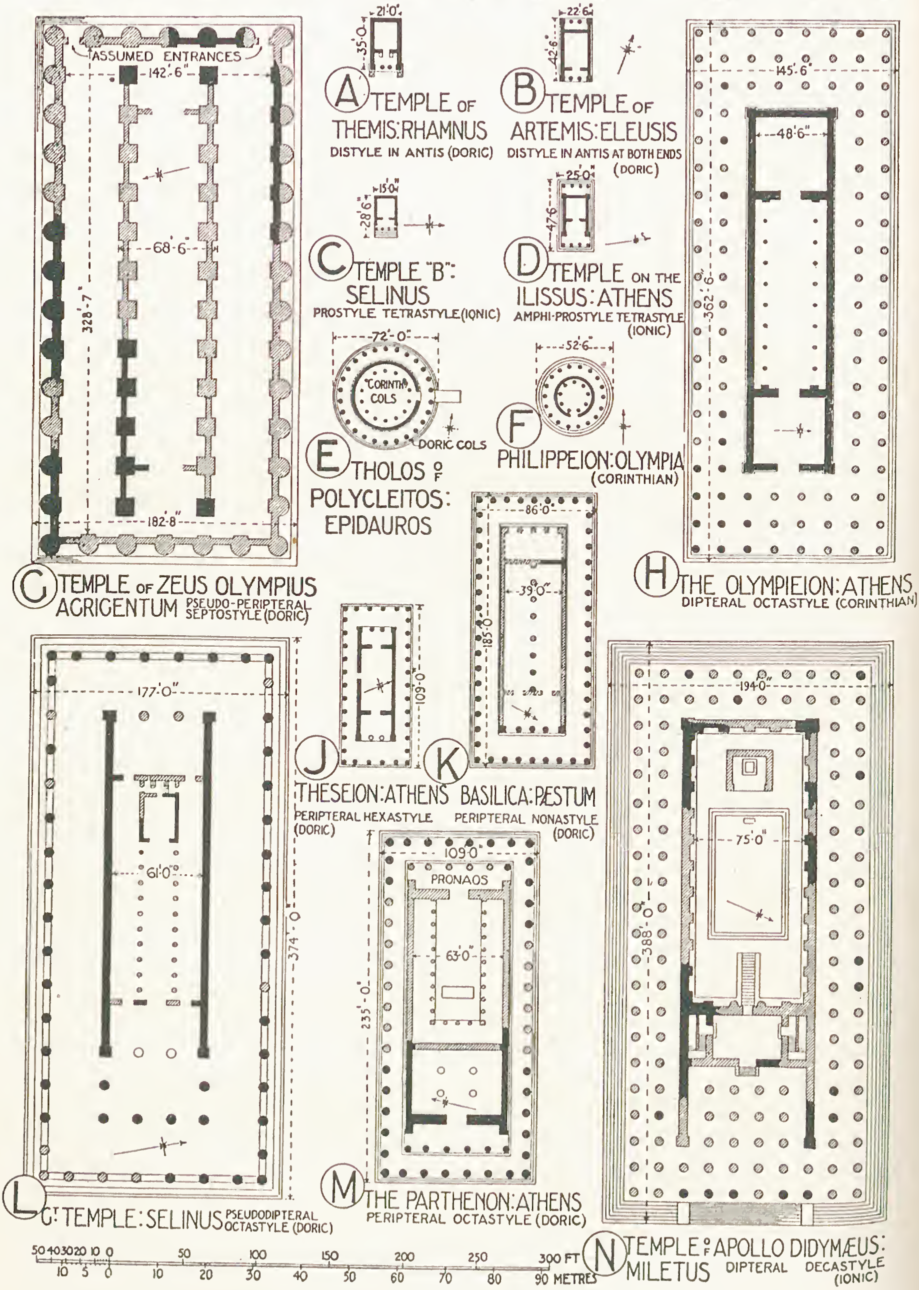
A fine example of the Ionic order. Showing the Porch of the Maidens on the south.

Porch of the Maidens on the south, in which an entablature without frieze is supported by six female figures—a difficult *motif* to treat satisfactorily, but in this case every care has been taken to give the figures the appearance of doing their task easily. The plan of the Erechtheum is unusual in Greek work, being unsymmetrical, but it has been suggested that a further wing was intended to the west, which would have resulted in a more nearly symmetrical scheme.

The treatment of the western wall with half-columns is of the Roman period.

The Greek Ionic order is much more slender than the Doric, the columns being normally 9 diameters high. There is a base, usually consisting of members circular in plan only, the lower square slab being common in Roman times. The shaft usually has twenty-four flutes separated by fillets, but it is the capital with two volutes on each of the front and back faces, connected with "bolsters" at the sides, which is the leading characteristic. This order was most easily used *in antis*, for its use as an angle column raises difficulties in the capital, usually overcome by arranging volutes on each of the outer faces, the volutes at the corner meeting at an angle of 45°. The columns of the Erechtheum are unusual in having a band of ornament round the upper part of the shaft, just below the capital. The architrave was normally arranged

COMPARATIVE PLANS OF GREEK TEMPLES



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The Erechtheum—The Porch of the Maidens, Athens
This is an entablature without frieze supported by six female figures.

with three fascias, the upper ones projecting slightly in front of the lower, with a capping moulding. The frieze was often omitted, particularly in the eastern colonies, but when used was either quite plain or treated with sculpture. In the case of the Erechtheum it was of dark marble, to which white marble figures were attached. The cornice consisted of three parts, the bed mould, the central vertical face with soffit below, and the crowning moulding. The bed mouldings, particularly in the east, often included a dentil course.

Early Ionic Examples

In early examples of the order there are often a much larger number of flutes, while in the early Temple of Diana at Ephesus there were sculptured lower drums to the columns, and in the later temple on the same site there were also sculptured pedestals. It should also be noted that while the normal Greek Ionic base consisted of upper and lower torus mouldings separated by a scotia, the early examples usually consist of a torus over a disk, both members frequently having subordinate mouldings. The most striking difference, however, in the earlier buildings of the Ionic order is the boldly projecting form of the capital, giving it a long narrow plan and a bracket-like construction, strongly suggesting a timber origin, a theory which is supported by the normal set of three fascias in the architrave and the use of dentils.

Greek Ornament

In the northern portico of the Erechtheum there is a fine example of a Greek doorway, narrower at the top than at the bottom, with a delicately moulded architrave, surmounted by a cornice, the ends of which are supported by voluted brackets or consoles. The Erechtheum, like many other Greek buildings of the Ionic order, is rich in mouldings and in repeating ornament such as the egg and dart, leaf and dart, and the anthemion ornament ; the former of these is remarkable for the subtle beauty of its curves and its deep cutting, while the latter is a remarkable example of graduated rhythm.

In studying Greek ornament, the relationship between the lines of the enrichment and the section of the moulding should be carefully noted.

The special case of the use of the Ionic order as a series of half-columns on the ends of short projecting walls in the interior of the Temple of Apollo at Bassae should be noted, particularly with regard to the detail of the capitals.

Examples of Greek Corinthian Buildings

The Corinthian order was used in only a few Greek buildings, and it was left to the Romans to develop this order to the fullest extent and to use it with ease and freedom. The internal columns of the

Tholos at Epidauros (340 B.C.), were of the Corinthian order, and fortunately one of the capitals was carefully preserved. The only example which may be earlier is the single column at the end of the cella of the Temple of Apollo at Bassae. This temple was built about 430 B.C., and if the Corinthian column formed part of the original structure—which is somewhat doubtful—it gives a clue to the later developments. The order may possibly have developed from certain types of capital used in Egypt: Assyrian carvings show the use of capitals with Corinthian-like leaves; and it has also been suggested that earlier capitals were of stone with the addition of leaves of bronze, a theory supported by the detail of the capitals of the Monument of Lysicrates. A further suggestion is that the Corinthian capital is a development of the type of Ionic used in the Erechtheum, which has a band of ornament round the shaft just below the capital.

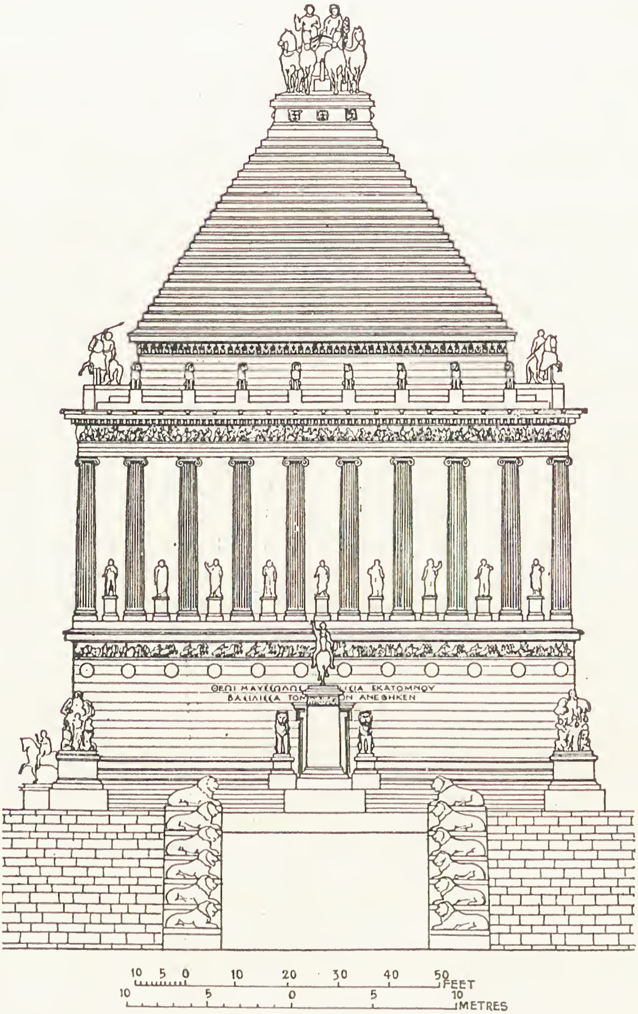
In its fully developed form the order is rather more elaborate than the Ionic and more slender, the columns being about 10 diameters high. The capital has a moulded abacus with four concave faces, the angles being chamfered off on plan. The main part of the capital is bell-shaped, and has two tiers of acanthus leaves in the lower part, and in the upper part two volutes meeting at each angle, and another two meeting in the centre of each face and supporting a flower form in the centre of each curved face of the abacus. In early examples the detail differs somewhat, the faces of the abacus in some cases meeting in acute angles, and the centre flowers being below the abacus. The early capitals are also considerably less covered with foliage than are the later ones.

The Monument of Lysicrates

The best example of Greek Corinthian is the Monument of Lysicrates, at Athens, erected 335-334 B.C. This is a circular structure, on a pedestal which is only 9 ft. 6 in. square. Six columns projecting slightly more than half their diameter from the circular wall support an entablature, above which is a roof of domical form. The entablature is similar to that of the Ionic order, the frieze in this case being sculptured. The capitals are very beautifully executed, and it may be noted that between the leaves on the lower part of the bell are rosettes, which may possibly have been derived from the pins with which metal leaves may have been secured in earlier capitals.

Tower of the Winds

A late example of Greek Corinthian is to be found in the Tower of the Winds, which was built at Athens, 100-35 B.C. This structure is interesting, partly because of its octagonal plan, partly because of its water-clock and sun-dial, but also because of the Corinthian order, which, owing to its great simplicity, was frequently used as a model



THE MAUSOLEUM AT HALICARNASSUS, RESTORED (350 B.C.)

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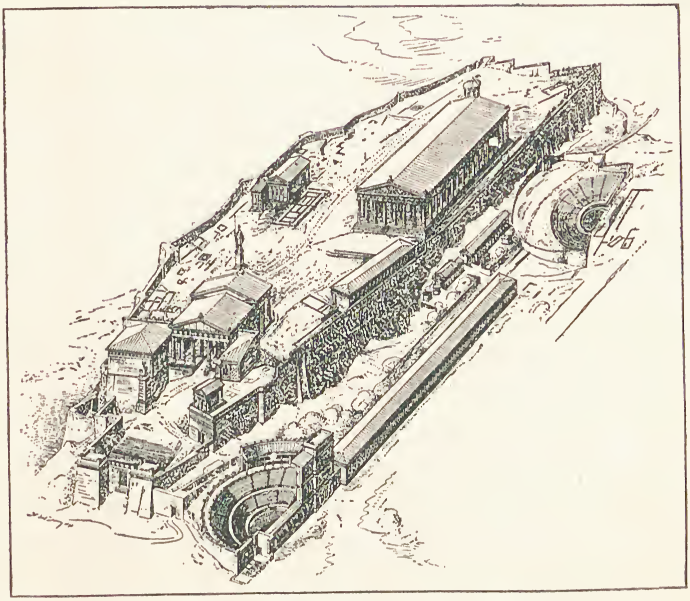
THE MONUMENT OF LYSICRATES
An example of the Greek Corinthian order.

in the less elaborate work of the Greek Revival. The columns are only about $8\frac{1}{3}$ diameters in height, they have no bases, and are fluted with twenty flutes. The capital has a moulded abacus, square on plan, with a lower tier of acanthus leaves, an upper tier of sixteen palm leaves, and no volutes or centre-flowers.

A LATE EXAMPLE OF GREEK CORINTHIAN—THE TOWER OF THE WINDS, ATHENS

This structure was built during 100 to 35 B.C. It is interesting partly because of its octagonal plan, partly because of its water-clock and sun-dial, but also because of the Corinthian order, which, owing to its great simplicity, was frequently used as a model in the less elaborate work of the Greek Revival. The columns are only about 8⅓ diameters in height, they have no bases, and are fluted with twenty flutes.



BIRD'S-EYE VIEW OF THE ACROPOLIS, ATHENS

(Restored by Professor Durm)

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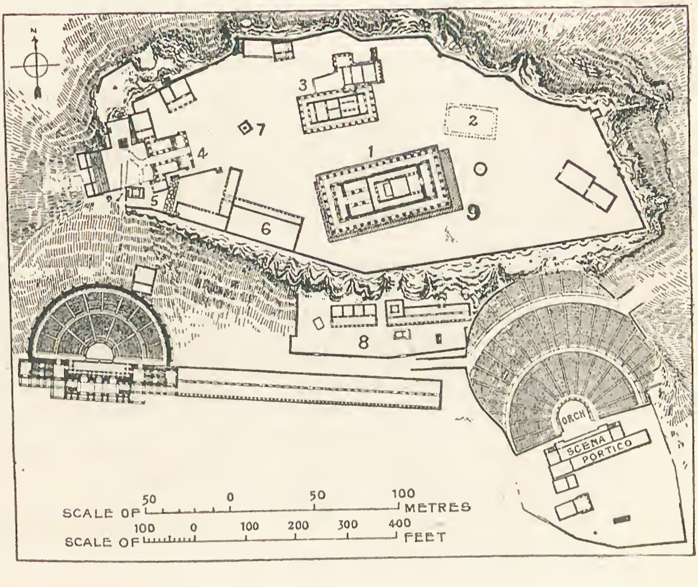

PLAN OF THE ACROPOLIS, ATHENS

(1) Parthenon; (2) platform on which stood the Great Altar of Athene; (3) the Erechtheum and the old smaller Parthenon; (4) the Propylæa; (5) Temple of Nike Apteros; (6) the Chalcotheke, or Treasure House; (7) colossal statue of Athene Promachos; (8) the Pinakotheka; (9) Substructure of Cimon.

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Importance of Greek Architecture

These " orders " as used by the Greeks are worthy of the most careful study, as they form the basis of so much subsequent architectural design, and through the study of them a considerable appreciation of architectural proportion may be gained. Perhaps, however, the main advantage of the study of Greek architecture arises from the fact that it cannot fail to impress the serious student with the importance of striving after sheer perfection, and of rejecting the second-rate. Particularly in the case of the buildings of the Doric order, Greek architecture also impresses because of its clear-cut directness, and above all because it is essentially a case of the triumph of the elimination of the non-essential. Every item to the smallest detail plays a definite part, contributing its share to a completely unified whole.

Greek Town Planning

Those Greek towns which were laid out as a whole during the great period of Greek architecture show considerable evidence of town-planning skill, the main scheme being that of two principal streets crossing at right angles in the centre of the town, where the most important buildings were grouped. The Greeks also showed great ability in the selection and use of fine sites, an excellent example being the case of the Temple of Juno at Agrigentum. Certain of the buildings on the Acropolis at Athens have already been considered as individual examples, but their placing on a remarkably fine and commanding site is particularly noteworthy.

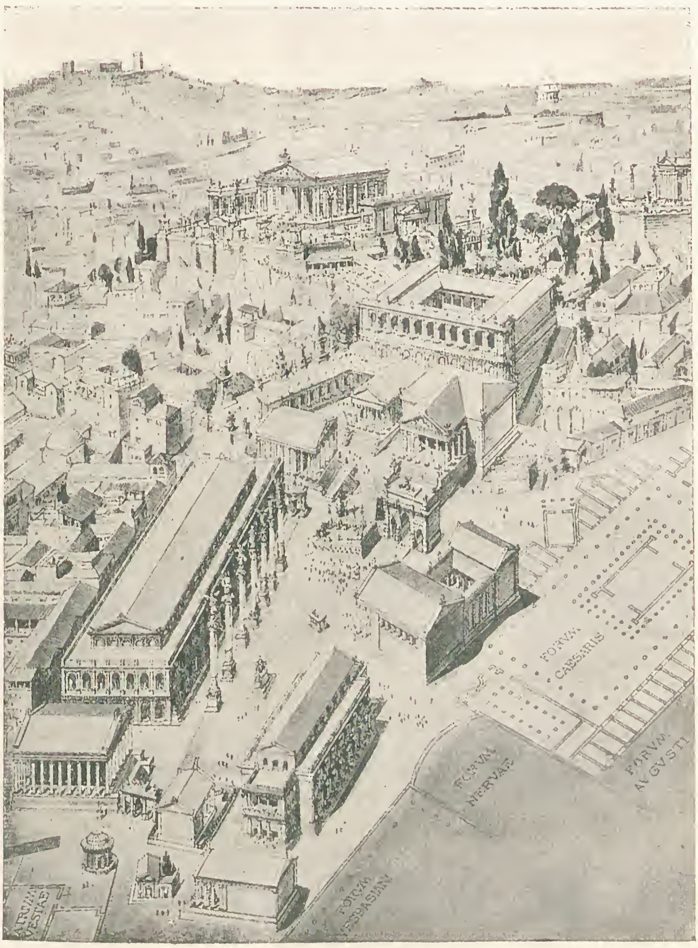
It will be noticed that the buildings on this site are not arranged in a symmetrical scheme, and it has been claimed that these buildings were deliberately arranged asymmetrically so that they would fit in better with their natural surroundings. A further claim has been made that as they were approached, interest developed in a manner not possible in a symmetrical scheme. It should, however, be borne in mind that the siting of many Greek buildings, especially in the case of the temples, was largely settled by the position of much earlier structures.

REFERENCE BOOKS

Auguste Choisy : *Histoire de l'Architecture.*
Anderson, Spiers, and Dinsmoor : *The Architecture of Ancient Greece.*
D. S. Robertson : *Handbook of Greek and Roman Architecture.*
Sir Banister Fletcher : *A History of Architecture on the Comparative Method.*
F. M. Simpson : *History of Architectural Development*, Vol. I.
Stuart and Revett : *Antiquities of Athens.*
J. Pennethorne : *The Geometry and Optics of Ancient Architecture.*
F. C. Penrose : *Principles of Athenian Architecture.*
F. Haverfield : *Ancient Town Planning.*
M. and C. H. B. Quennell : *Everyday Things in Archaic Greece. Everyday Things in Classical Greece.*
Arthur Stratton : *The Orders of Architecture.*

PART III.—ROMAN ARCHITECTURE

THE period of Roman architecture may be taken as starting in 146 B.C., the date of the Roman conquest of Greece, and as ending in A.D. 330, when the Eastern Empire was founded. In the earlier part of this period, the work was normally more refined than in the later days, when size was generally thought of greater importance than



THE FORUM ROMANUM
(Restored by L. Levy, Karlsruhe)

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detail. In the early work the constructional method was normally that of the column and lintel, whereas in the later work the arch, vault, and dome are the leading constructional features. It should be noted, however, that the arcuated Theatre of Marcellus was built 13 B.C., and that a number of the later temples are of trabeated construction, the ecclesiastical buildings tending to adhere to the Greek tradition, whereas the secular buildings were generally in the newer fashion, using the pier, arch, and vault.

INTERIOR OF THE GREAT HALL, BATHS OF CARACALLA
As restored by Cockerell. (Early third century, A.D.)

Reproduced from *A Short History of Architecture*, by H. H. Statham (Batsford).

Roman buildings were by no means confined to Italy, fine examples being constructed in many other parts of the empire. It was only in Egypt that the local tradition was too strong, and buildings similar to those constructed in Rome are to be found in various towns in Germany, France, Spain, North Africa, Syria, etc. In England and Wales there are remains of numerous Roman buildings, unfortunately mainly of foundations only.

Roman Building Materials

The chief building material of the Romans was concrete, the ingredients of which were available in all parts of the empire, and which required few skilled workmen to direct the labour of many unskilled labourers. Stone was used to a considerable extent both for construction and as a facing, being normally used for construction in blocks of considerable size, though the vast stones used in the substructure of the Temple of the Sun at Baalbec were exceptional. When concrete or brick was used for the walling, the surfaces were covered with mosaic, or with marble cut in thin slabs to show the figure, and arranged in panels. Stucco was also used to a great extent as a covering material.

Roman architecture owes much to Greece, and to the Etruscans who were the first to use the true arch with radiating voussoirs, an example being the Cloaca Maxima, in Rome, a great sewer with a semicircular arch of about 5½-ft. radius. Roman temple design was also influenced to some extent by the temples of the Etruscans, which often had three cellas side by side, with an extensive portico in front.

Greek temples were, of course, to be found in parts of Italy, and after the conquest of Greece many Greek art treasures were brought to Rome, and many Greek artists came to that city, while Roman architects also studied in Athens. Greek architecture was the last and best of a long series of trabeated styles. Roman architecture, combining the Etruscan arch with the Greek column and lintel, was the first of a great series of arcuated styles.

Broadly speaking, Roman architecture shows great skill in construction and ability in planning, not only individual buildings of considerable magnitude and intricacy, but also groups of buildings. It was, on the other hand, particularly in the later days of the Empire, frequently weak in its lack of refinement and in its lavish use of ornament.

Construction

In Roman construction there were two main types of walling, namely unfaced concrete, normally used in foundations, and concrete faced in a variety of ways. Of the latter the oldest is known as "*opus incertum*," in which the concrete was faced with pieces of stone irregular in shape. In "*opus reticulatum*" the concrete was faced with stone spikes, each about 3 in. square on the face, tapering to a point and laid diagonally.

AN EXAMPLE OF A ROMAN AQUEDUCT—THE PONT DU GARD, AT NÎMES, FRANCE

Note the projecting voussoirs which were used to support the centering necessary for constructing the upper part of the arch.

In other cases concrete was faced with triangular bricks laid in courses breaking joint, with bonding courses about 4 ft. apart, made of flat bricks nearly 2 ft. square. The bricks vary in thickness from 1 in. to $1\frac{3}{4}$ in., and the mortar joints were about 1 in. thick. A fourth type of walling was similar to the last, but had bands of stone at intervals, instead of the brick bonding courses. The facings of brick and the *opus reticulatum* were normally covered with marble or stucco.

Brick arches were made with the majority of the brick voussoirs going only about 6 in. into the concrete, but with bricks going right through the wall at intervals.

How Romans Built Arches and Vaulting

In building arches, whether of stone or of concrete, timber centering was used, and in many cases the arch sets back at the springing level to allow the timber centering to rest on the pier. In other cases the lower part of the arch was built without centering, projecting voussoirs being then used to support the centering necessary for the upper part of the arch. The Pont du Gard at Nîmes is a good example of this type of construction.

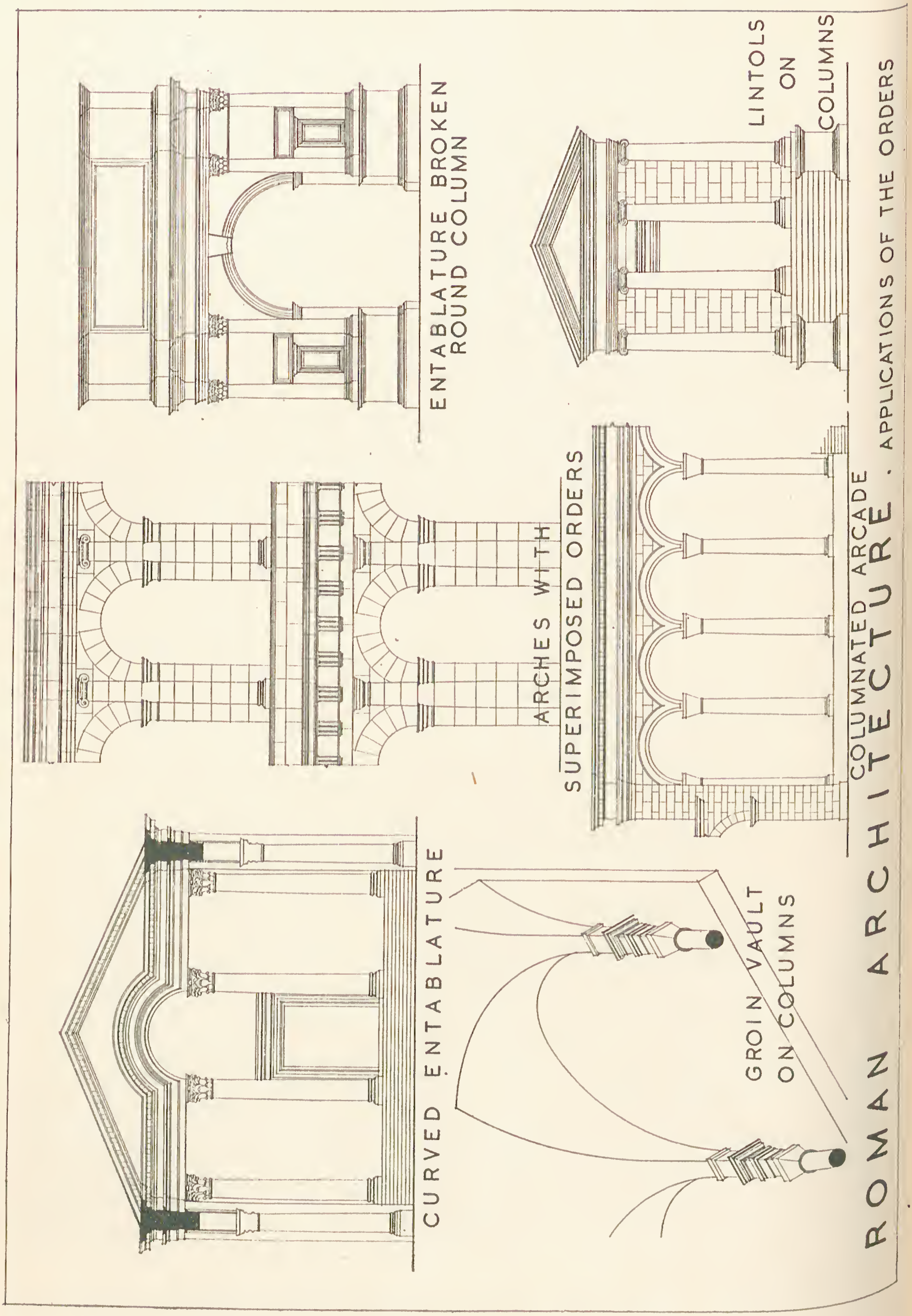
The use of the arch to span openings in the outer walls allowed supports to be placed farther apart, and the use of the vault and dome permitted the use of wide, covered spaces uninterrupted by supports, the spans reaching to 80 ft. and over. These vaults were normally of concrete, which, while by no means entirely eliminating thrust, no doubt reduced it considerably, and massive supports were used to resist it.

Barrel vaulting, a continuous semicircular arch, is the simplest type ; its disadvantages are that it needs a continuous support on each side, and that it is not easy to introduce light above the springing level except at the ends.

Intersecting or groined vaulting, consisting of one barrel vault running the length of the apartment, intersected at right angles by other barrel vaults, has the great advantages of needing support only at definite points, and in allowing ample space for the introduction of windows well above the springing level on all four sides.

In constructing these vaults everything possible was done to reduce the amount of timber centering. In the case of barrel vaults, light wooden centering was used to support brick arches about 2 ft. apart, joined at intervals by brick bonders, the spaces between being filled with concrete. In another method the brick arches were placed farther apart, and planks placed between them to support the first layer of concrete, further layers being added until the required strength was obtained. In a third method, a light wooden centering was used to support a layer of large, square tiles bedded in cement, with smaller tiles placed above, some being put vertically so as to grip the first layer of concrete, which would be succeeded by other layers as before.

In the case of intersecting vaults the groin ribs were formed of a rib


ENTABLATURE BROKEN ROUND COLUMN
LINTOLS ON COLUMNS
ARCHES WITH SUPERIMPOSED ORDERS
COLUMNATED ARCADE
CURVED ENTABLATURE
GROIN VAULT ON COLUMNS
ROMAN ARCHITECTURE . APPLICATIONS OF THE ORDERS

of tiles at the angles, bonded at intervals to a similar rib on each side of it. When these set, the spaces between the ribs were filled with concrete forming groin ribs of sufficient strength to support the infilling from groin to groin.

Domes and semi-domes were constructed of concrete somewhat similarly, with ribs at intervals starting at the springing, meeting in a circle or semicircle near the top, and connected by a series of bonding courses.

The under sides of these concrete vaults and domes were frequently treated with deeply sunk or "coffered" panels, formed by placing moulds in position before depositing the concrete, or by the more laborious process of hewing out the concrete.

In some special cases, such as the Baths of Diana at Nîmes, the vaults were formed of stone, transverse arches of that material being used to support stone slabs laid across from rib to rib. It is important to note that in the case of these baths at Nîmes, the thrust of the central barrel vault was taken by a similar but smaller vault over a corridor at each side.

Use of the Greek Orders in Roman Architecture

In Roman architecture the three Greek orders, Doric, Ionic, and Corinthian, were used with certain modifications, together with the Composite order, which is a combination of the Corinthian with the larger volutes of the Ionic. A further order, the Tuscan, which is a simplification of the Doric, is also attributed to the Roman period, but no actual example of Roman Tuscan remains; it was, however, frequently used in the Renaissance. It is simpler than the Doric in having no triglyphs in the frieze, and neither mutules nor dentils in the cornice; the shaft is unfluted, and the column is 7 diameters high. The Doric order was but seldom used in the Roman period. In the few examples which remain, the Roman Doric column is much more slender than the Greek, being normally 8 diameters in height. The shafts are often unfluted, and if fluted the flutes are separated by fillets. The column has a base in some examples: its capital lacks the subtlety of the Greek. It is often stated that in Roman Doric the end triglyph comes over the centre of the column, but there is no example remaining of a Roman Doric building arranged in this way.

The Roman Ionic order differs from the Greek mainly in its lack of refinement. The Roman Ionic base usually has a square slab below the circular mouldings, and the top fillet of the scotia usually comes exactly below the fillet over the top torus. The shafts are frequently unfluted, the capitals have smaller volutes, the curved band joining one volute to the other in Greek examples is missing, and in the case of the Temple of Saturn at Rome there are four angular volutes to each capital, all canted at an angle of 45°. The examples of the Ionic order at Pompeii are particularly interesting.

The Corinthian order was more fully developed in the Roman period,

MAISON CARRÉE, NÎMES—ONE OF THE FINEST AND BEST-PRESERVED ROMAN TEMPLES IN EXISTENCE

early examples being more like the Greek, but in the later part of the period the spiky foliage of Greek times gives place to rounder and less deeply cut foliage, and there is far greater elaboration of carved ornament. In the cornice a series of brackets, known as modillions, is introduced under the soffit of the corona, usually arranged with square panels on the soffit between the modillions. Well-known examples of the Roman Corinthian order are to be found in the Pantheon and the Temple of Castor and Pollux—both in Rome. The capital of the Corinthian order of the Temple of Vesta, at Tivoli, is very different from the typical: Soane based his order at the Bank of England on this example.

The Composite Order

In the Composite order the main scheme is much like that of the Corinthian, but there is even greater profusion of ornament, and the larger volutes of the Ionic are introduced above the normal foliage of the Corinthian capitals. The Arch of Titus, Rome (A.D. 81), is the earliest example.

Broadly speaking, the main differences between the Greek and Roman

orders are the greater elaboration of the latter and the greater delicacy and refinement of the former. Roman shafts are often unfluted, and the Roman architrave is normally in line with the outer face of the shaft at the top, whereas in Greek architecture the architrave projects to a point about midway between the upper diameter of the shaft and the face of the abacus.

How Romans Used the Orders

It is, however, the various ways in which the Romans used the orders that are of major importance, and these may be classified as follows :—

(1) Columns standing free, and used as supports for lintels as in Greek work. This is the method principally used by the Romans in the porticoes of their temples.

(2) Columns and entablatures used as a decorative treatment of a flat wall surface, or in combination with a construction of pier and arch type. This latter was a normal Roman treatment for theatres, amphitheatres, and other secular buildings. The columns in these structures project rather more than half their diameter from the face of the pier, and the entablature was not supported by the columns, but was corbelled out from the pier. As a result of this the lintel was commonly less deep than in Greek work. It will be noticed that in this arrangement the columns are much farther apart than in Greek work, those of the Theatre of Marcellus being spaced about $5\frac{1}{4}$ diameters centre to centre, and those of the Colosseum, $7\frac{1}{2}$ diameters.

(3) Superimposed orders. In Greek architecture it was seen that in the interiors of the Doric temples a tier of columns was often placed over another tier, but that both tiers were of the same order. In Roman buildings the orders were often arranged one above the other, Doric being the lowest, followed by Ionic, Corinthian, and Composite. In later days, when the Tuscan was used, it was placed at the lowest level. In such an arrangement as this the lower diameter of a column in any upper tier is the same dimension as the upper diameter of the column immediately below.

(4) In the interiors of the great Roman halls, the groined vault usually sprang from a block of entablature over a column in front of each pier.

(5) In certain later buildings, such as Diocletian's Palace at Spalato (Split), the central lintel in a portico was given the shape of an arch, and this was followed by the architrave and cornice.

(6) Columns, projecting slightly more than half their diameter, were sometimes used in such a way as not even to appear to support a projecting entablature, the latter being projected in front of the wall only over each column.

(7) Toward the end of the Roman Empire, in certain special cases, such as Diocletian's Palace at Spalato, columns were once more given their proper place as supports by being arranged with arches resting

THE TEMPLE OF VESTA, TIVOLI

A magnificently sited temple which fits in with its natural surroundings.

directly on them, a method further developed by the Early Christian and Byzantine builders.

The Use of Pedestals

In Greek work, pedestals were rarely used, the Temples of Diana at Ephesus being exceptional cases. In Roman work, pedestals forming part of a continuous feature were used in such buildings as the Theatre of Marcellus and the Colosseum, where they were employed in connection with each order. They were also used in the lower part of many of the temples, and in numerous triumphal arches pedestals were used in order to give greater height to the order without increasing the size of the parts.

Roman Planning

Generally speaking, Roman planning shows the use of thick walls and a small number of large supports, giving the large, uninterrupted floor space necessary in public buildings. In the case of the temples, with the exception of a few vaulted examples, Greek precedent of thin walls and a larger number of small supports was followed.

Individual buildings were planned on axial lines, and in many buildings openings were arranged on the axes, giving long and interesting vistas.

Sites were also laid out symmetrically, buildings being arranged in formally disposed groups combining to form a single architectural conception. In few cases are buildings arranged to fit in with natural surroundings—an interesting example being the magnificently sited Temple of Vesta at Tivoli.

Roman Town Planning

Great developments, probably owing something both to Greek precedent and to the Terramare settlements of the Bronze Age in North Italy, were made in the art of town planning during Roman times. The general lines of the schemes were somewhat similar to those of the military camps, with two main thoroughfares crossing at right angles, with the forum (originally the market-place and the scene of gladiatorial displays, but later the town centre), and round this were grouped the most important buildings. In many Roman towns, particularly those in the eastern part of the empire such as Damascus, Palmyra, Antioch, and Gerasa, streets were constructed with colonnades on each side supporting roofs over the side avenues, and having monumental archways at the intersections of the streets. In Palmyra such a street was formed over a mile in length, and each column facing the main avenue was provided with a corbel to support a statue. In Rome, the number of fora was so great that colonnaded streets were not necessary. These schemes of town planning, including not only colonnaded streets and fora, but also the

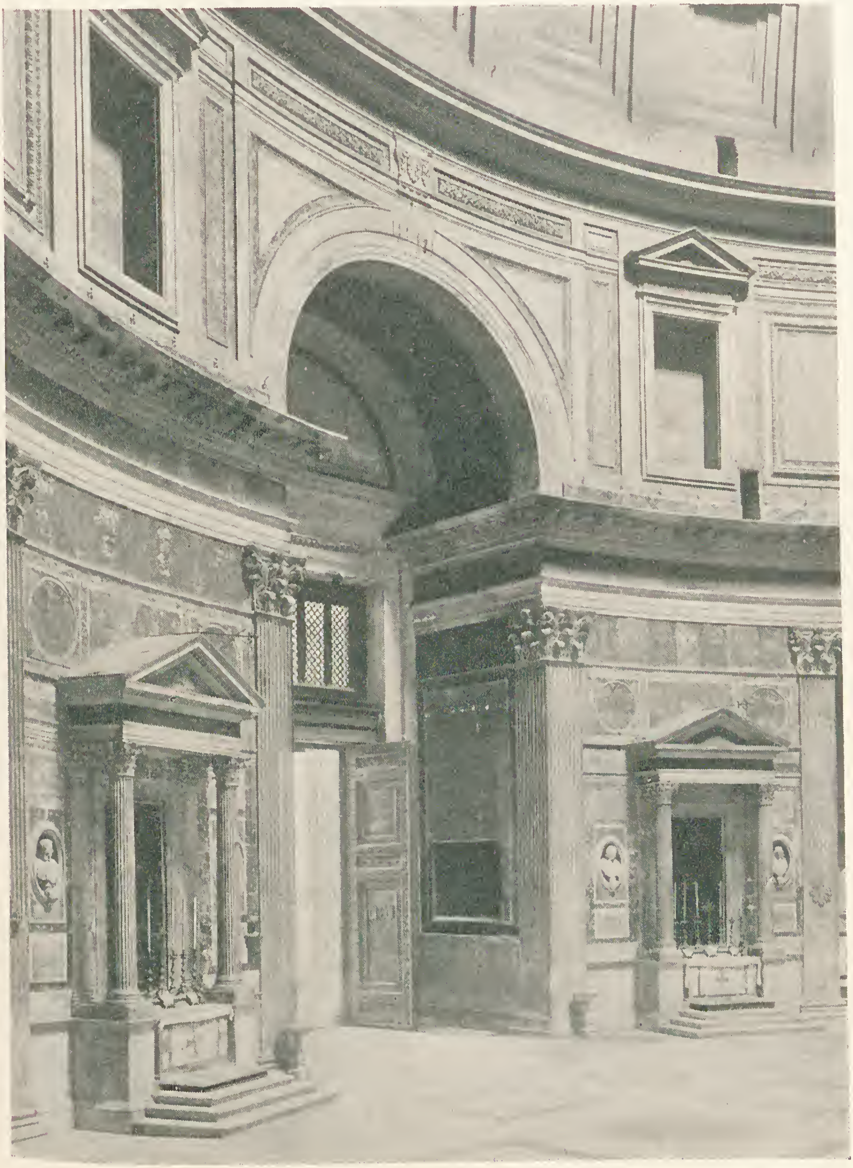
EXTERIOR OF THE PANTHEON, ROME
This is a leading example of a circular Roman temple. See pictures on following pages.

grouping of important buildings to form fine architectural conceptions in the manner previously described, made Roman cities efficient, and also gave them a dignity worthy of a great empire, a combination of qualities rarely met with at the present time.

The Basilicas or Halls of Justice

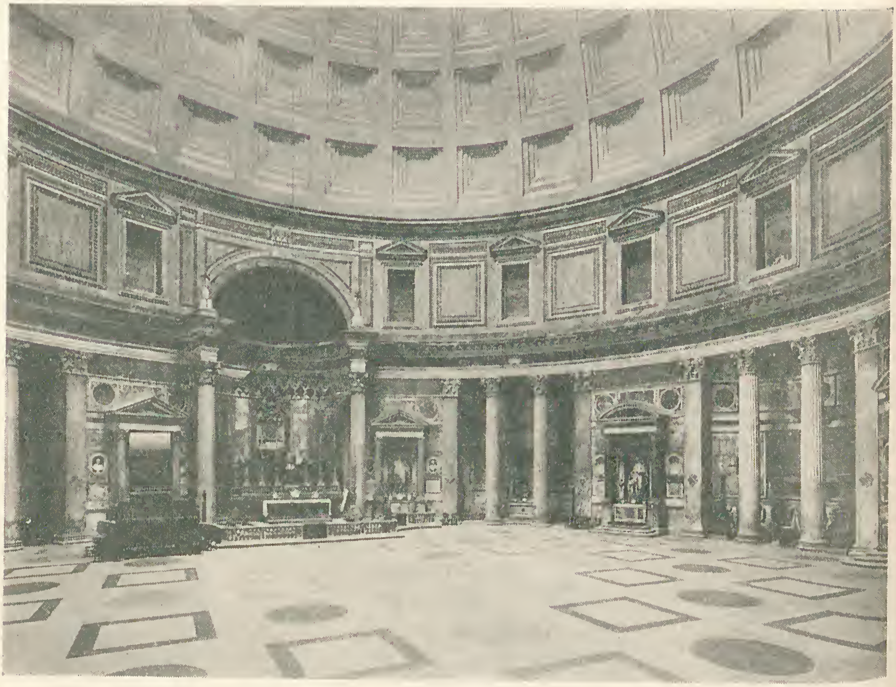
A study of the various types of buildings constructed by the Romans may well begin with the Basilicas, or Halls of Justice, of which there were two types: one in which the construction is more or less based on Greek methods, having a timber roof supported on many internal columns, the other having concrete vaults resting on a small number of large supports.

Of the first type, the Ulpian Basilica, or Basilica of Trajan (A.D. 98), may be quoted as a good example, and special attention may well be paid to the excellent way in which it is planned in relation to surrounding buildings; while the Basilica of Constantine (A.D. 312) is a fine specimen of the vaulted type. In both types the main scheme usually consisted of a long rectangle, with an apse at one end for the tribunal, generally cut off from the rest of the building by a screen of columns. In the case of the



THE PANTHEON, ROME—THE INTERIOR, LOOKING TOWARDS THE PORTICO

Basilica of Constantine the main hall, 265 ft. by 85 ft., is covered by an intersecting vault in three bays, with three recesses 74 ft. by 56 ft. on each side, covered with barrel vaults. The recesses were lighted by windows in the side walls, and the main hall by windows over the side

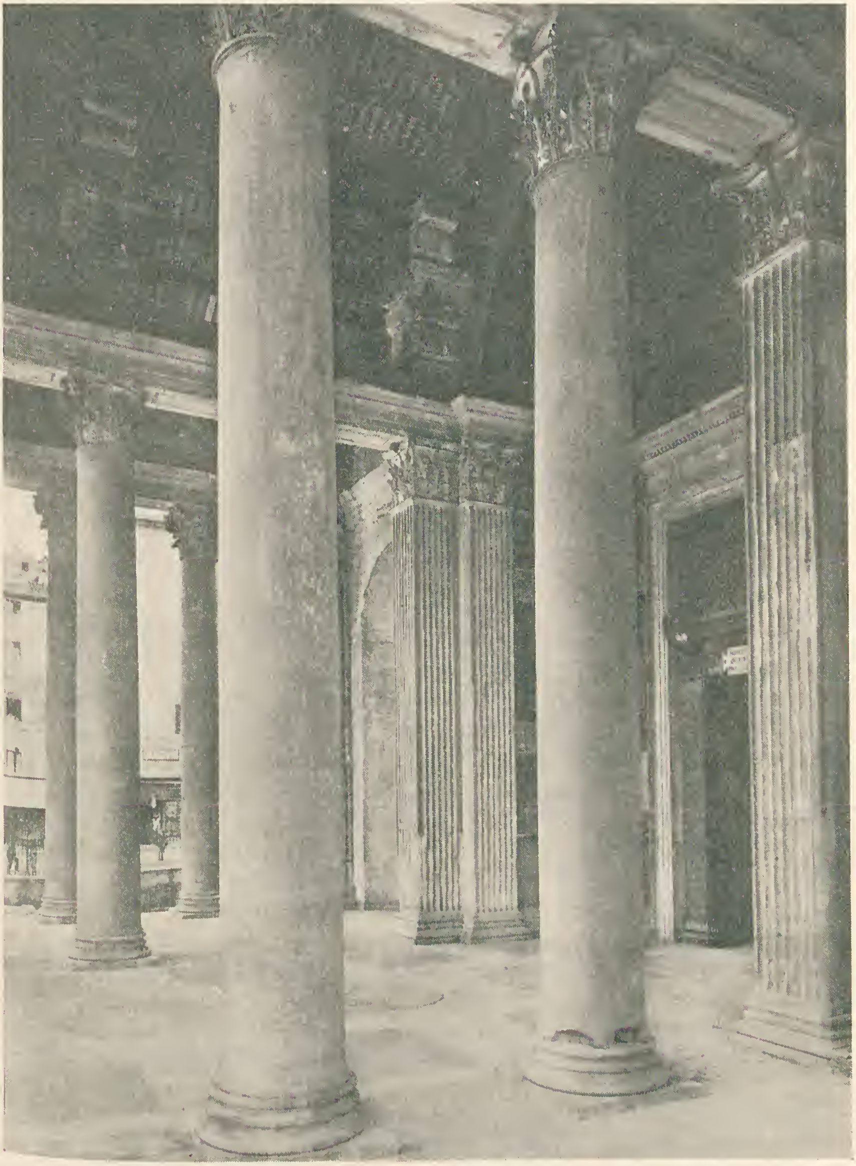


THE PANTHEON, ROME—THE INTERIOR

vaults arranged in the height of the intersecting vault. Two apses with semi-domes over were provided, one in the central recess on the north side, and the other at the west end. The plan of this basilica is of great importance, being at the root of much subsequent planning.

Roman Temples

Roman temples are usually rectangular, a few are circular, and there are some special cases with polygonal plans. In most of them Greek precedent was followed in construction, only a few being vaulted. Greek temples were normally intended to be seen all round, whereas Roman examples were often arranged so that the sides and rear were comparatively unimportant ; and whereas the Greek temple was normally raised on a platform only three steps in height, a Roman temple was usually approached by a long flight of steps, flanked by projecting walls continued to form a podium, or continuous pedestal, round the lower part of the structure. This flight of steps gave considerable importance to the temple entrance, and that was further emphasised by enlarging the portico. Often there was no portico at the rear, even when a colonnade was arranged on the flank, but the usual scheme was one in which there was no



THE PANTHEON, ROME—THE PORTICO

colonnade either at the side or at the rear, attached pilasters being used instead of free-standing columns.

The omission of the side colonnade, and increased skill in the construction of roofs, enabled the Roman architect to give greater width to

THE COLOSSEUM, ROME

the main hall or cella of the temple, and in some cases an apse was constructed at the end opposite the entrance.

Roman temples were rather shorter in proportion to their width than Greek temples, a Roman temple usually having on each flank twice the number of columns at the end minus one, as compared with twice the number of columns at the end plus one in Greek temples; and while Greek temples were normally built on a north and south axis with entrance at the east end, Roman temples would have an eastern entrance only if that arrangement would fit in well with the general scheme. An excellent example of a Roman rectangular temple, but without apse, is the temple at Nîmes, generally known as the Maison Carrée.

Of polygonal temples, the vaulted Temple of Jupiter in Diocletian's Palace at Spalato (Split), A.D. 284, is especially noteworthy, being octagonal externally, but internally it is circular, and having a series of recesses, alternately semicircular and rectangular.

The circular Temple of Venus at Baalbec (A.D. 273) is a particularly interesting example, having a very ingenious external treatment consisting of eight Corinthian columns, six of which are placed at some distance from the wall of the temple, and are connected by an entablature curving on plan, while the other two help to form a rectangular portico.

About 100 yards to the north of the Temple of Venus is a fine example of group planning, the great scheme including a propylæum, an hexagonal court and a rectangular court (surrounded by rectangular and semicircular exhedræ) forming the precincts of the great rectangular Temple of the

THE INTERIOR OF THE ROMAN COLOSSEUM FROM THE HIGHEST GALLERY

Sun, in the substructure of which are the great stones to which reference has already been made.

The Pantheon at Rome

The leading example of a circular temple is the Pantheon, at Rome, which consists of a rotunda built about A.D. 120, with a portico originally built as the entrance to another temple 27 B.C.–A.D.14, but taken down and rebuilt in its present position at a later date. The rotunda has an internal diameter of 142 ft. 6 in., and its wall, about 20 ft. thick, has eight recesses, similar to those referred to in the temple at Spalato, which was probably based on the Pantheon. This wall supports a dome, deeply coffered on the under side, originally covered with bronze externally, and having a circular opening about 28 ft. in diameter at the crown.

The planning of the portico is an able piece of work, the disposition of the columns and of the niches being particularly worthy of study.

The Baths

Of all the many types of buildings erected by the Romans, the bathing-establishments are the most important from various points of view, and especially as examples of planning well worthy of study. In these buildings a large number of rooms, used for various inter-related purposes, was arranged not only so as to give great efficiency in working, but also so that the finest æsthetic results were achieved. In addition to the excellent planning of the accommodation required in the main building, many subsidiary structures were required in the surrounding space, and these also were arranged with great ability, so that the complete scheme of a Roman bathing-establishment formed a great group of buildings planned with consummate skill, while the interiors were lavishly decorated with mosaic floors, walls treated with coloured marble in the lower part and stucco above. The columns were of marble, and above these were the deeply coffered barrel and groined vaults. One of the finest of such establishments was the famous Baths of Caracalla, built in Rome about A.D. 210. In this scheme the main building was about 750 ft. by 380 ft., the dominating feature of the plan being the principal hall—the *tepidarium* (warm room)—about 170 ft. by 80 ft., covered with a groined vault, and having three subsidiary apartments on each side, each covered with a barrel vault. The general arrangement of this central part of the scheme followed closely in both plan and section that of the Basilica of Constantine. Other important rooms in the central block were the *frigidarium* (the cool room, usually containing a swimming-bath), and the *calidarium* or hot room, which in this case was probably a circular room about 120 ft. in diameter covered with a dome. It is important to note that on the north-east side of this block there were few entrances, but in the south-west side there were numerous large openings leading to the gardens,

ROME. INTERIOR OF THE COLOSSEUM

It had seats for 50,000 and standing-room for 30,000 more. The seat of the Emperor was above stone pillars on right.

etc., an example of paying attention to aspect, a subject seemingly neglected in so much modern work.

The central block was constructed near the middle of a vast platform about 1,200 ft. square, the lower part being utilised for shops on the road front, and for stores, slipper baths, etc., while the platform itself was laid out for games, and provided with stands from which various sports could be witnessed, together with lecture-rooms and covered recesses for discussion, etc. It is probably true to say that in no other buildings left to us from the past may the great art of planning be studied to greater advantage.

Theatres

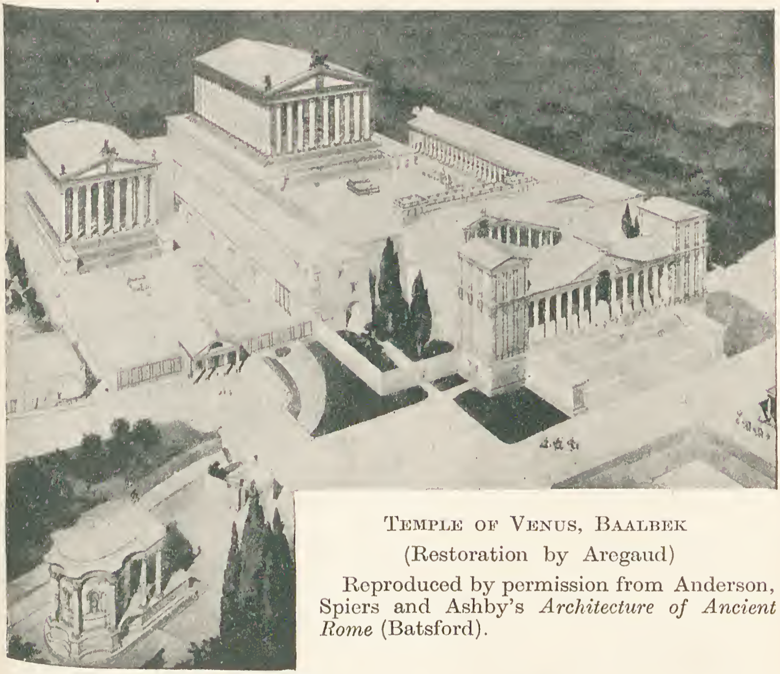
The Roman theatre differs from the Greek in being semicircular in plan—whereas the Greek plan was normally more than a semicircle; in being built up from the level—whereas the Greek theatre was usually worked out of the side of a hill; and in the greater importance given by the Romans to the stage buildings. Remains of these theatres are to be found in all parts of the Roman empire, notably at Athens, Pompeii, and Orange in South France. The best-known one is probably the Theatre of Marcellus in Rome (23–13 B.C.), of which two storeys of the auditorium remain.

Amphitheatres

More important than the theatres are the amphitheatres. Of these, again, remains are to be found in such widely separated places as Pompeii, Verona, Nîmes, Arles, and Caerleon. The finest example is the Colosseum in Rome, in the form of a great ellipse, about 620 ft. by 510 ft. externally, very ably planned with regard to the arrangements for getting the vast number of spectators to their seats, and for emptying the building at the end of the performances. The structure is four storeys in height, with eighty openings in each of the three lower storeys, those on the ground floor being used as entrances. The major part of the structure was erected A.D. 70–82, but the top storey—which does not improve the composition—was added A.D. 222–44.

Triumphal Arches

In dealing with Roman town planning, reference was made to the triumphal archways erected at the junctions of the colonnaded streets. Fine archways were also constructed at the entrances to towns, as at Autun; as approaches to bridges as at St. Chamas, near Arles; as monuments in honour of military successes, and—in rarer cases—as a memorial of a domestic achievement. These arches are of many types—single-arched, triple-arched, etc., and provide an interesting study in architectural composition; and while some, like the Arch of Constantine in Rome are overcrowded with architectural features and sculpture, others, of



Temple of Venus, Baalbek

(Restoration by Aregaud)

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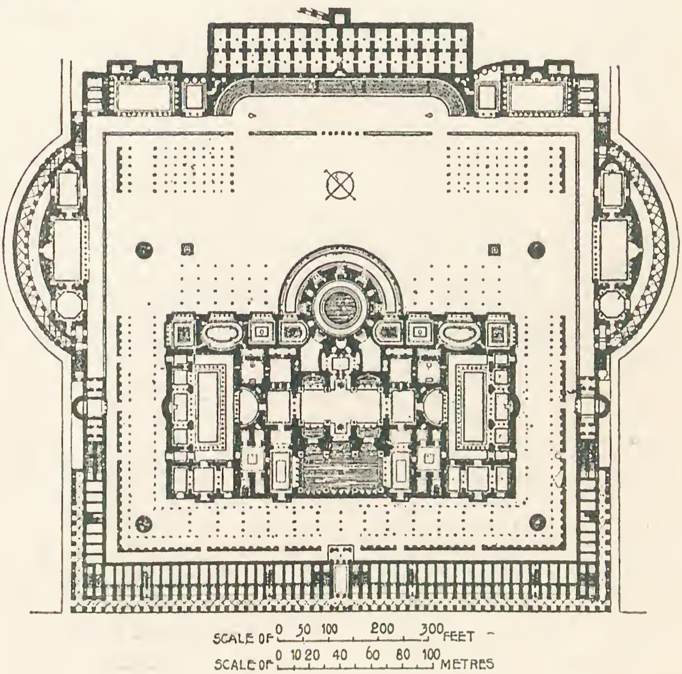


Plan of the Baths of Trajan

(As restored by Charles A. Leclere)

Reproduced from Anderson, Spiers and Ashby's *Architecture of Ancient Rome* (Batsford).

THE ARCH OF TITUS, ROME

which the Arch of Titus in Rome may be quoted as an example, show a more commendable restraint.

Bridges, Aqueducts, and Monuments

Of the many fine bridges constructed by the Romans, the one at Alcantara may be quoted as an example of the many-arched type, and that at Toledo as a specimen of a single-span bridge.

Roman aqueducts were constructed to carry water to many cities in

THE HOUSE OF PANSA, POMPEII

different parts of the empire, water being used in Roman cities to a far greater extent per head of the population than at the present time. Of these aqueducts, the most important is doubtless the Pont du Gard at Nîmes, in which may be seen projecting voussoirs built some distance above the springing in order to support a reduced amount of centering.

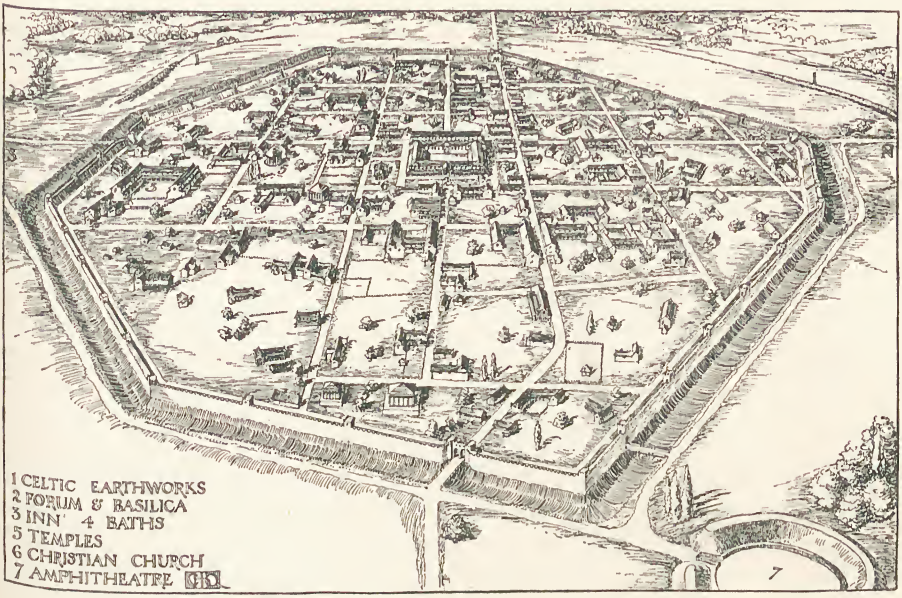
Roman monuments include the well-known Trajan's Column, constructed in close relationship with the Ulpian Basilica, in Rome. There is a full-size cast of this column in the Victoria and Albert Museum in London. Other Roman monuments which may be mentioned are the Monument at S. Remi, in Provence, and the Igel Monument, strangely suggestive of the early Renaissance, at Treves.

Of the monumental tombs, that of Cecilia Metella, and the Mausoleum of Hadrian, both in Rome, and the remarkable rock-cut tombs at Petra, should be noted.

Houses

Various examples of Roman houses, somewhat similar to those constructed in the Greek period, are to be found—notably in Pompeii, where the House of Pansa may be taken as an excellent example, having

THE INTERIOR OF THE BASILICA AT SILCHESTER
Reproduced from *Roman Britain*, by M. and C. H. B. Quennell (Batsford).



SILCHESTER (CALLEVA ATREBATUM)
Reproduced from *Roman Britain*, by M. and C. H. B. Quennell (Batsford).

an entrance leading to a partially roofed outer court, from which a colonnaded inner court is reached, both courts being surrounded by apartments. Nero's Golden House, of which but little remains, and the vast palace of Diocletian at Spalato (Split), in which Mestrović's great statue in bronze in memory of Gregor Niksić has recently been erected, may be mentioned as examples of Roman domestic work on the biggest scale.

REFERENCE BOOKS

H. H. Statham: *A Short Critical History of Architecture.*
F. M. Simpson: *History of Architectural Development*, Vol. I.
Sir Banister Fletcher: *A History of Architecture on the Comparative Method.*
D. S. Robertson: *Handbook of Greek and Roman Architecture.*
Anderson, Spiers, and Ashby: *Architecture of Ancient Rome.*
Auguste Choisy: *L'art de bâtir chez les Romains.*
Histoire de l'architecture.
M. and C. H. B. Quennell: *Everyday Life in Roman Britain.*
R. P. Spiers: *The Orders of Architecture.*
A. Stratton: *The Orders of Architecture, Greek, Roman, and Renaissance, and their Application.*
J. M. von Mauch: *Die Architektonischen ordnungen der Griechen und Römer.*

PART IV.—EARLY CHRISTIAN, BYZANTINE, AND ROMANESQUE ARCHITECTURE

IN the year A.D. 303 the emperor Diocletian ordered the destruction of all Christian churches. These first churches were normally single, oblong rooms, but in some cases there were two rooms, one longer than the other, with an archway in the dividing wall.

Constantine, in A.D. 313, issued a decree giving Christianity equal rights with other religions, and ten years later he professed Christianity, and it became the religion of the Roman Empire, thus giving an impetus to church building, which was the main building activity of the period. The new churches built at this time are commonly referred to as basilicas, or basilican churches, possibly because it was thought that they were Roman basilicas of the timber-roof type converted into churches. Others suggest that they were deliberately copied from the timber-roofed basilicas, which they certainly resemble, but it should be borne in mind that certain of the characteristics of the Early Christian churches are to be found in Greek and Roman temples.

Development of Early Christian Churches

As the followers of the new religion increased in number, the churches developed by the addition of an apse with semi-dome at the end opposite the entrance, set apart for the clergy, and screened off in later days, with the altar placed in front of the screen, while as the churches increased in

CHURCH OF ST. APOLLINARE IN CLASSE, RAVENNA (SIXTH CENTURY)

CHURCH OF ST. APOLLINARE NUOVO, RAVENNA (SIXTH CENTURY)

size the nave had to be subdivided by means of two rows of columns, which simplified the roof problem, and allowed of the introduction of the clerestory. A narthex was placed across the entrance end of the church, the aisle was sometimes continued across this end of the interior, and in one or two cases galleries for women were arranged over the side aisles. In front of the apse a transept or "bema" was arranged, and this scheme of a transept near the altar end of the church persisted in many later Italian examples. In some cases an apse was placed at the end of each aisle, giving three parallel apses. The choir was formed by means of a screen at the end of the nave near the altar, with a gospel "ambo" or pulpit at the north side and the epistle "ambo" at the south side. At the entrance end of the church there was usually a cloistered atrium, frequently having a baptistery on the end facing the entrance. The introduction of infant baptism in later years led to the placing of fonts in churches, and the consequent abandonment of the baptistery.

It is important to note that up to the end of the fourth century early

Christian churches in Italy were normally arranged with the entrance at the east end and altar at the west end, but after the fourth century this arrangement was gradually reversed.

Construction of Early Christian Churches

The constructional scheme was a simple one : the roofs being of timber of about 30° pitch, only light supports were required, and these were provided by thin outer walls, and by columns supporting the clerestory walls, which allowed of windows over the roofs of the aisles and under the eaves of the nave roof.

In the early buildings of the style in Rome the columns were usually classic ones taken from the older buildings, and frequently had differing capitals, and had to be altered in height to fit in their new position. In some cases the columns support lintels, and in others, niches. Sometimes the arches rest directly on the capitals, as in the late Roman example in Diocletian's Palace, but in other examples a dosseret, stilt block, or impost block is introduced between the capital and the arch, somewhat on the lines of the block of entablature used between column and vault in the Roman halls.

The windows were filled with pierced slabs of marble or lattice work of bronze. When, in the ninth and tenth centuries, windows were glazed, their size was considerably reduced. The great amount of wall space in Early Christian churches was in some cases treated with marble inlay, in others it was covered with paintings, but in many examples finely designed schemes of decoration were arranged in mosaic of strong colours, with a background of gold. Floors were of marble mosaic, ceilings in Rome were often deeply panelled in wood, but away from Rome the roof was normally exposed. The exteriors were particularly simple, the interiors being considered of far greater importance.

In addition to the churches of the rectangular type described above, there were the circular churches of S. Stephano Rotondo, Rome, with timber roof, and the domed church of S. George, Salonica. There were also noteworthy baptisteries, such as the octagonal one attached to S. Giovanni in Laterano, Rome. Of the tombs, the one erected in Rome by Constantine for his daughter, in the year A.D. 330, is particularly interesting, with its dome supported on twelve pairs of granite columns, as is also the extraordinary tomb of Theodoric at Ravenna, cruciform internally, decagonal externally, and covered by a roof formed of one block of stone weighing over 450 tons.

BYZANTINE ARCHITECTURE

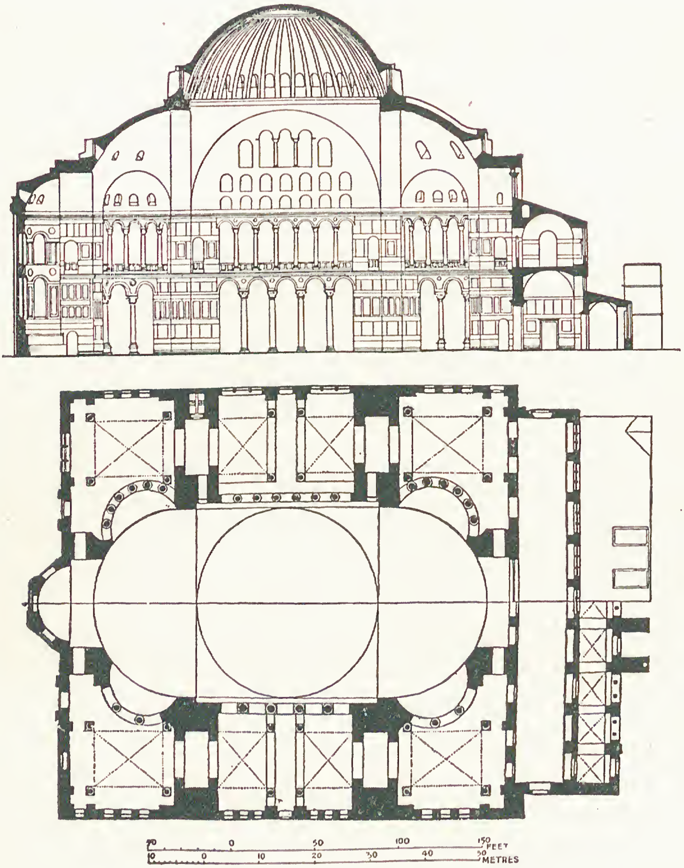
In the year A.D. 324, Constantine moved his capital to Byzantium, renaming it Constantinople, and in A.D. 364 the empire was divided into eastern and western parts, a similar separation in the Church follow-

ST. SOPHIA, CONSTANTINOPLE (ISTANBUL)

ing. While architecture of the type just described was developing in the western area, in the eastern part a different style, known as Byzantine, was being worked out.

The Use of the Dome on Pendentives

Essential features of this style are the centralised type of plan and the use of the dome, which was enabled to cover a square compartment by the use of pendentives. In the simplest type of dome on pendentives, the dome and the pendentives all form part of one hemisphere ; of this type the tomb of Galla Placidia, Ravenna (A.D. 420), may be mentioned as an example. In the compound type the dome is a separate hemisphere, placed on top of the circle formed by the pendentives. A further development was that in which a drum, usually cylindrical but sometimes polygonal, was placed between the pendentives and the dome, while in other cases there is a false drum formed in the height of the dome. These domes were much thinner than those of Roman construction, and were generally of brick. Usually the exterior of the dome was exposed, but in some cases, notably at Ravenna, the dome was formed of light pottery jars or tubes and covered with a roof.



LONGITUDINAL SECTION AND PLAN OF SANTA SOPHIA, CONSTANTINOPLE

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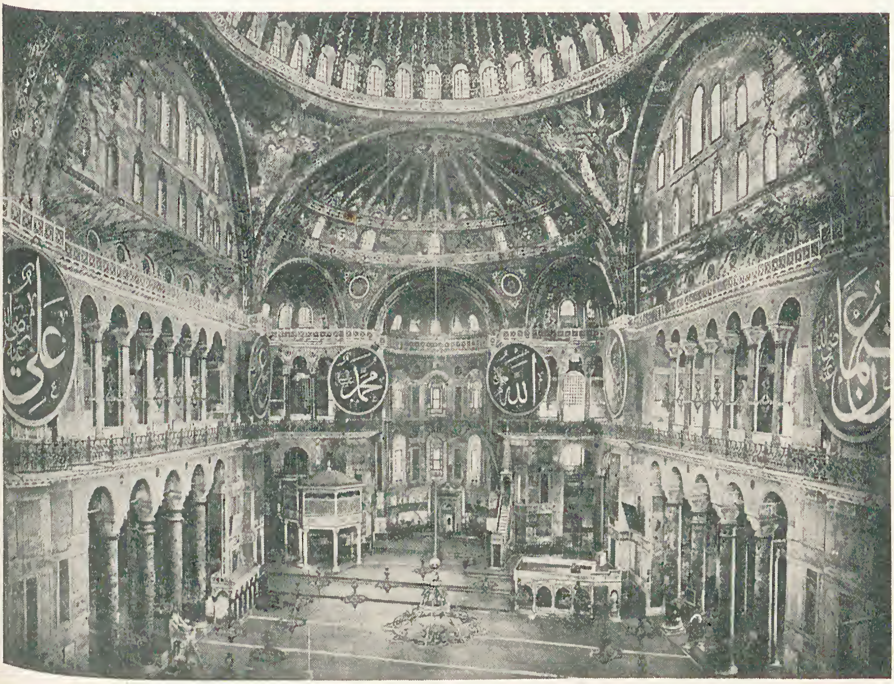
Windows were formed in connection with Byzantine domes in various ways, being placed below the arches in the case of simple domes; in the dome, immediately above the springing, in the case of compound domes without drum (as at Santa Sophia, Constantinople); and in the drums where those were used. In some cases in which lofty drums were used, generally octagonal, windows were formed with their arches intersecting the dome, but in other cases the window was kept completely under the drum. Where false drums were used, these were pierced by the windows.

The supports were on the Roman method, few and comparatively large, but more slender than Roman. They were generally of brick, the bricks being about 1½ in. thick, and the joints about the same. Externally, walls were of stone in some cases, but more often of brick and stone, bricks in some cases being inserted in vertical as well as horizontal joints. The exteriors are plain, but interesting because of the definite attempt to use brick as a decorative material, in some cases bricks being cut into ornamental forms, while string courses of thicker bricks set diagonally were very common. Interiors were richly treated with large slabs of marble (cut to show the figure) in the lower part, with glass mosaics above.



ST. SOPHIA, CONSTANTINOPLE (ISTANBUL)

Columns frequently had marble monoliths for shafts. Capitals varied considerably in design, some being based on Corinthian, others on Ionic, while others again resembled Doric, but had small Ionic volutes. These capitals were usually provided with dosserets, but other capitals were designed specially to take the arch without the dosseret, and in some cases capitals of this type were also used with the dosseret.

Carving was frequently of interlacing patterns ; it was generally light in appearance, incised, and having deeply drilled holes.

The normal plan of the churches of the early part of the Byzantine period was a square externally, with certain octagonal exceptions. Internally there were aisles separated from the central space by means of piers, and frequently niches terminating with semi-domes were arranged between the piers.

The Church of Santa Sophia, Constantinople

The finest example of this part of the period is the great church of Santa Sophia at Constantinople, in which the plan resembles that of the Basilica of Constantine in its main lines, but having great apses arranged in the end compartments on the long axis, with smaller apses entered from the great ones, the whole scheme culminating in a great dome supported on pendentives over the central area.

ST. MARK'S, VENICE

Other noteworthy examples of early date are the churches of St. George at Ezra, SS. Sergius and Bacchus at Constantinople, St. Vitale at Ravenna, and the orthodox Baptistery at Ravenna.

In the later part of the period the most interesting example is St. Mark's, Venice, originally a basilican church, but rearranged in its present form toward the end of the eleventh century. The plan is of Greek-cross type, with a central dome and one over each arm of the cross, separated by broad arches. Much work in this building is of later date.

There are, however, many other interesting examples, including a number of churches in Greece of the eleventh and twelfth centuries. These churches are of two types, one type being larger than the other. In the larger type, there is usually a low dome over a central space the full width of the bema plus the side chapels, the dome being supported on piers; whereas in the smaller type there is usually a dome on a lofty drum the width of the bema alone, the dome being supported on columns. The Monastery of S. Luke of Stiris in Phocis is particularly interesting, including as it does two churches, one of each of the above-mentioned types. The church of S. Elias of Salonica has, in addition to the eastern apse, north and south apses to the transepts, a scheme which was followed in certain Romanesque churches of Germany.

ROMANESQUE ARCHITECTURE

While Byzantine architecture continued to flourish in the Eastern Empire, the early Christian architecture of Italy gave way, towards the end of the tenth century, to a new method of building based on Roman precedent and known as Romanesque. This style, with various modifications, spread through Germany, France, and England, and prevailed in those countries until toward the end of the twelfth century.

Principal Developments

Leading points in the development of this style are the use of vaulting in place of the timber roofs of early Christian work, and the consequent use of substantial piers in the place of columns.

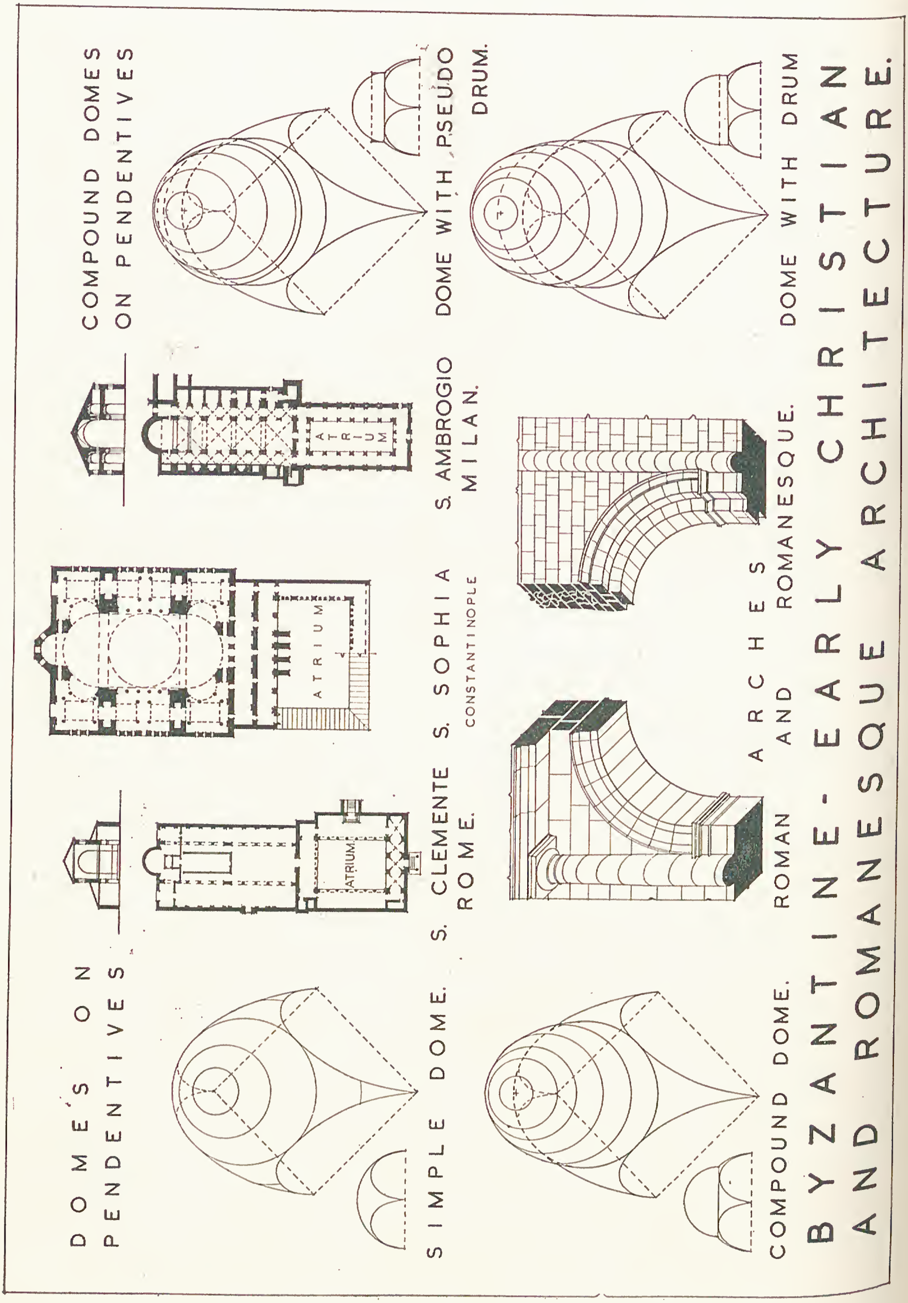
The Use of Recessed Arches

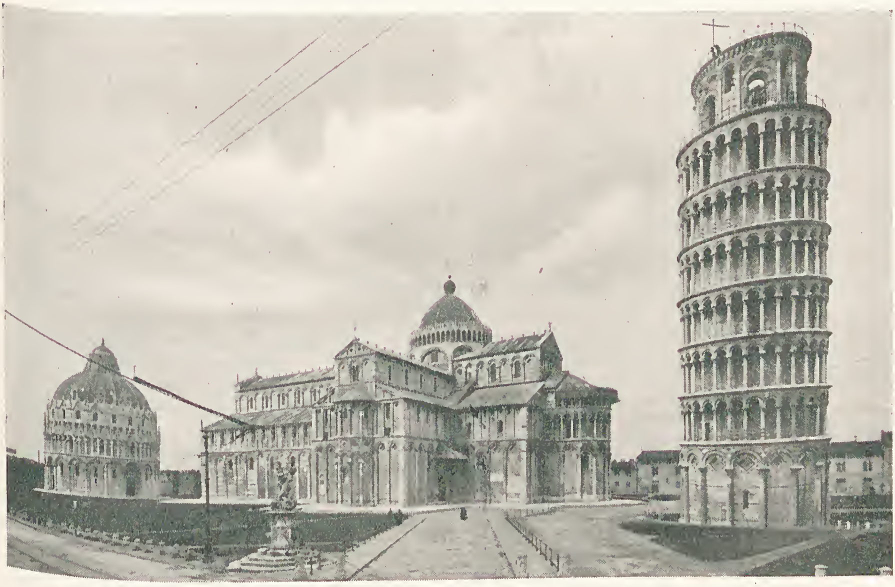
It should be realised that this was an earlier Renaissance than that usually accepted as such—an attempt to build in the Roman manner. The inability of the builders to use the large blocks of stone normal in Roman work led to the use of recessed arches instead of the Roman flat soffit. This may seem a small matter at first consideration, but, as has been well shown by Sir T. G. Jackson, it had remarkable developments, leading, as it did, step by step to such noble effects as those shown in the magnificent portals of Bourges, Chartres, and Rheims. The use of small stones also led to a more elastic scheme of construction than that developed by the concrete vault of the Romans, the principle of equilibrium being tentatively employed—a new principle in comparison with the inert stability of Roman architecture.

Vaulting Arrangements

In the normal vaulting scheme, groined vaults were used over square bays, one square of the nave fitting in with two square compartments in each aisle, the nave piers being made heavy and light alternately. In the early part of the period the vaulting was usually without ribs, the groins being the lines of intersection of semicircular barrel vaults, but later in the period definite ribs were constructed at the groins, and this led to a completely different conception of the vault.

These diagonal ribs were usually semicircular, especially on the Continent, rising to a greater height than the wall arches and cross-arches, and giving a domical form of vault. In England, vault ridges were normally kept level, so that either the groin ribs were semicircular, and wall ribs and cross-ribs stilted, or the wall ribs and cross-ribs were semicircular, and the diagonal ribs segmental or half-elliptical.


DOMES ON PENDENTIVES
SIMPLE DOME.
COMPOUND DOME.
S. CLEMENTE ROME.
ATRIUM.
S. SOPHIA CONSTANTINOPLE
ATRIUM
S. AMBROGIO MILAN.
ATRIUM
ARCHES
ROMAN AND ROMANESQUE.
COMPOUND DOMES ON PENDENTIVES
DOME WITH PSEUDO DRUM.
DOME WITH DRUM
BYZANTINE - EARLY CHRISTIAN AND ROMANESQUE ARCHITECTURE.



PISA—THE BAPTISTERY, CATHEDRAL, AND LEANING TOWER
The Tower leans towards the Cathedral.

It will be noted that the scheme works reasonably well so long as all the vaulting compartments are square, but that with the use of oblong bays further difficulties would arise, and in the case of the specially shaped vaulting bays, necessary in the aisle passing round an apse, even greater difficulties were met with, overcome only in part by using the well-known highly stilted arch in the apse.

In some cases in the later part of the style a vaulting rib was taken up from the intermediate pier, and the compartment of the vault divided into six parts, giving sexpartite vaulting.

The Use of the Pointed Arch

With the development of the use of the pointed arch in the later days of the twelfth century, it was gradually realised that not only did this form reduce the thrust considerably, but also that, as a pointed arch of a given width can rise to any desired height greater than half its span, oblong bays could be used, giving one bay of the nave to one bay of the aisle, and all the supporting piers could be similar ; while the special difficulty in dealing with the vault of the aisle round the apse was readily overcome by this method.

In the plan, there is a general development of the use of the transept, and in some countries of the chevet—a treatment of the apse with surrounding aisle and radiating chapels.

In the different countries in which Romanesque architecture developed

the style varied considerably, in some cases the buildings in various parts of the same country differing strikingly.

Italian Romanesque Work

In Italy, for example, Romanesque work may be subdivided into three types: northern, central, and southern.

In the northern division, ribbed quadripartite and occasionally sexpartite vaulting was used over square divisions, two divisions of the aisle to one of the nave, with piers alternately large and smaller, the plans being cruciform in some cases but not in others, while the use of apses was normal.

Externally the use of slender columns or pilasters was common, with arcades under the eaves and gables. The west ends sometimes had a single gable, but in other examples the lower roofs over the aisles were indicated at the west end. The porch in the centre of the west end was a striking feature, the gabled roof being supported by columns resting on the backs of lions or other animals. Above the porch there was usually a rose window. S. Michele, Pavia; S. Zeno, Verona; and S. Antonio, Piacenza, are good examples of Northern Italian Romanesque.

The Central Italian, Pisan, or Tuscan Romanesque style is well exemplified by the well-known group at Pisa, consisting of baptistery, leaning tower, and cathedral, the last being a cruciform church with double aisles to nave and choir. In the interior the general scheme is less altered from the early Christian type: arches with flat soffits being supported on columns, and timber roofs, either open or with flat ceilings, being normal. The exteriors are marked by the extensive use of superimposed attached, or detached, wall arcades.

In southern Italy and Sicily the architecture of the Romanesque period shows the effect of Byzantine influence in the planning of certain churches, in the use of the dome—over a square space—supported on columns, and in the use of dosserets. Mahomedan influence may be traced in the decoration, while northern influence shows in the use of arches with recessed "orders"; sometimes, as in the cloisters at Monreale Cathedral, these arches are inadequately supported by capitals more classic in type. The architecture of this district is particularly noteworthy for the early use of the pointed arch.

Romanesque Architecture in France

Romanesque architecture in France shows many varieties, but fascinating as these are in themselves, their main interest is in their gradual transition toward Gothic.

In Provence, many of the churches show clearly the strong influence of a classic tradition. The porch of the church of Notre-Dame, Avignon, is an excellent example, while that of S. Trophime at Arles shows similar forms, but with a more vigorous mediæval feeling.

Some of the churches of Aquitania show Byzantine influence to a very marked degree, the church of S. Front, at Perigueux, bearing, in its main constructional lines, a striking resemblance to S. Mark's, Venice. Other churches of Aquitania show a more normal Romanesque development, the church of S. Sernin at Toulouse being a good example. This is a church with transepts and double aisles, while at the east end it has a well-developed arrangement of apse with passage-way round it, and radiating chapels of semicircular form beyond—a scheme known as the chevet. The nave is roofed with a barrel vault, having at intervals ribs which are brought down to the ground on the face of the piers. Over the triforium above the inner aisle are half-barrel vaults counteracting the outward thrust of the nave vault. These half-barrel vaults reach well up to the nave vault, and so there is no clerestory, but a certain amount of light enters the upper part of the nave from windows at the back of the triforium.

In the churches of the Auvergne very similar schemes were normal, the church of Notre-Dame du Port at Clermont Ferraud being typical.

The church of S. Étienne at Nevers, which is just north of the Auvergne, is a particularly interesting example, for here the semicircular barrel vault over the nave is placed above a clerestory, a somewhat dangerous building scheme, which is improved in certain of the churches of Burgundy by using pointed barrel vaults which reduce the outward thrust. The church at Autun is an excellent example of this type, and here fluted pilasters with Corinthianesque capitals and Attic bases are evidence of the powerful effects of classic influence. At Cluny the abbey had double transepts, a scheme which had little influence on later church planning in France, but which was adopted in certain cathedrals in England. In the churches of Burgundy, the narthex, either open or closed, is an important feature of the plan. There is a fine example of the closed narthex at the abbey church at Vézelay. Here, though there is a fine, early Gothic choir and notable Romanesque sculpture, particularly in the tympanum over the door between the narthex and the nave, the main feature of interest is the development of the vault in Romanesque times. Over the nave, built about A.D. 1100, is a groined vault with semicircular, transverse ribs, but no diagonal ribs, over oblong vaulting bays, while in the great ante-chapel of about A.D. 1130 similar vaults were constructed with pointed arches, but again without diagonal ribs.

The abbey church at Tournus is remarkable for a particularly original form of vault, semicircular arches being constructed across the church supporting barrel vaults running at right angles to the length of the nave. This allows of windows high up in the vault, but at the same time the thrust of the arches is brought down very low.

In Normandy, sexpartite vaulting was used as at the Abbaye-aux-Hommes at Caen, while at the Abbaye-aux-Dames in the same town each

CHAPEL OF THE TOWER, LONDON

of the intermediate transverse arches supports a vertical wall which subdivides the lateral compartments of a quadripartite vault.

It may be noted that, broadly speaking, during the Romanesque period in France, vaulting ribs are brought down to the ground by means of attached shafts on the face of the piers. Toward the end of the period there was a growing tendency to use circular piers, and then the shaft from the vault had to stop—rather awkwardly in some cases—above the abacus of the capital.

Romanesque Architecture in Germany

During the Carolingian period (approximately A.D. 800–900), a number of interesting buildings were erected in Germany, and of these the most important is the cathedral at Aix-la-Chapelle (about A.D. 800), a polygonal building on the lines of S. Vitale at Ravenna. In the tenth and eleventh centuries German churches, which were rarely vaulted, were normally arranged with an apse at the west end in addition to three apses facing east, a good example of this type being the abbey church at Gernrode, which has an interesting gallery connecting its western towers. The use of numerous towers was also typical of the period.

Of the later vaulted churches, some show the development of the use of the dome on squinches over the central space. Some churches of this type have the triapsal plan—apses pointing north, south, and east, as used in the Byzantine church of S. Elias at Salonica. Examples of this class are to be found at Cologne—the church of the Apostles, Great S. Martin, and S. Mary in the Capitol. In other vaulted churches, domical

quadripartite vaulting over square bays was used, with two bays of each aisle to one of the nave, the piers being alternately heavy and light. Examples of this class are the cathedrals of Worms, Spires, and Mayence.

The exteriors of German Romanesque churches are noteworthy for the numerous towers, with steep roofs of varying treatments. A typical scheme is that of a four-gabled tower with a roof formed of four diamond-shaped surfaces fitting the gables. Other features typical of German Romanesque are the use of arcading, particularly close under the eaves, and flat buttresses connected at the top by means of corbel tables. The general appearance of the exteriors is normally particularly picturesque.

The east end of the cathedral at Bonn may be mentioned as an excellent example of late German Romanesque, while near to Bonn, but across the Rhine, is the interesting double chapel at Schwartz Rheindorf. The double chapel is not uncommon in Germany; it consists of two chapels one placed over the other, the upper chapel probably being used in some cases by the nobility, while the retainers used the lower.

ENGLISH ROMANESQUE ARCHITECTURE

Anglo-Saxon Work

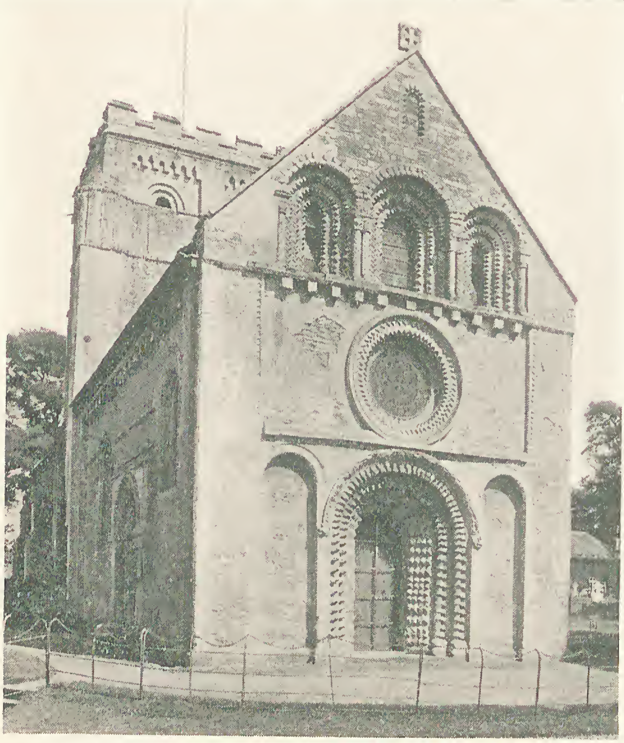
Post-Roman work in England before the Norman Conquest is known as Anglo-Saxon. The remains of the work of this period are mainly ecclesiastical, and are of importance principally because of the plan. This normally consisted of two compartments: the larger one being the nave and the smaller one the chancel. The latter in some cases has an eastern apse, but in others has a square east end. This is important, because although during the Norman period apsidal terminations of various types were developed, during the Gothic period which followed, the square east end of Anglo-Saxon times became normal.

Other features of interest are the "long and short" work at the quoins, and the pilaster strips. These project slightly in front of the general walling, with the exception of those portions of the "short" stone which project beyond the "long" ones, and it is probable that the walling was plastered in the intervening spaces.

Window openings were sometimes spanned by two stones leaning against each other, forming a triangular-headed opening, and others by a semicircular arch or a lintel cut into the shape of such an arch. In belfries, two windows with semicircular arches are often arranged side by side with a "baluster shaft" between, this shaft normally being circular on plan, but swelling in the centre of its height. This type of window is somewhat similar to those common in the smaller churches of the later Byzantine period.

Norman Architecture

Norman architecture or English Romanesque after the Conquest may be subdivided into Early (1066–1125), Late (1125–75), and Transitional



IFFLEY CHURCH CATHEDRAL, OXFORD—WEST END

(1175–89). The Norman church was usually cruciform, and normally longer in proportion to its width than French Romanesque churches. The east end was usually apsidal, some examples, like St. Albans, having parallel apses, and others, such as Norwich and Canterbury, having the French chevet.

Norman arches were usually semicircular, but when special circumstances required they were made stilted, segmental, or semi-elliptical. The early vault was of barrel form (nave of chapel of the Tower of London) or groined (aisle of chapel of the Tower of London). Later in the style, diagonal ribs were introduced, and these were usually segmental or semi-elliptical in curve, as the English vault was generally arranged with a level ridge. Early ribs were plain, later ones were moulded, and in rich examples they were treated with repeating ornament.

Norman capitals usually had an abacus square on plan and square-edged, but in the case of very large circular piers the plan of the abacus was necessarily circular. Early examples are simple, and have a convex shape in the lower part, while later ones are concave and tend toward elaboration. These capitals take many forms, the simplest being shaped in the easiest form of transition from the circle to fit the shaft to the square to fit the abacus. Some are scalloped, others have inverted volutes, while some again are Corinthianesque.

The offsets of the arches are treated with various repeating ornaments, such as the beak-head, the chevron, the billet, and the lozenge. The unit of this repeating ornament is usually decided by the size of the material, one ornament being carved on each stone.

Buttresses are broad and of small projection, and are connected at the top by a corbel table.

The various arrangements of the nave arcade, triforium, and clerestory are particularly interesting, and should be studied with care. Early examples have these three divisions approximately equal, but as the style advances the nave arcade is increased in importance, and the triforium is reduced. The triforium is also subdivided in various ways in the later examples. A special case is that of Christ Church Cathedral, Oxford, where the triforium is included under the nave arcade.

Norman doors and windows usually had semicircular arches, windows sometimes having a recessed arch with a shaft in each jamb, while doorways frequently had a number of such shafts and a corresponding number of " orders " of arches, each with its repeating ornament. The use of the lintel and carved tympanum between it and the arch occurs in certain cases.

REFERENCE BOOKS ON EARLY CHRISTIAN, BYZANTINE, AND ROMANESQUE ARCHITECTURE

Sir Banister Fletcher : *History of Architecture on the Comparative Method.*
F. M. Simpson : *History of Architectural Development*, Vols. I. and II.
H. H. Statham : *A Short Critical History of Architecture.*
C. A. Cumming : *History of Architecture in Italy.*
Sir T. G. Jackson : *Byzantine and Romanesque Architecture.*
Lethaby and Swainson : *Church of Santa Sophia, Constantinople.*
Schultz and Barnsley : *Monastery of S. Luke of Stiris in Phocis.*
Texier and Pullan : *Byzantine Architecture.*
J. Arnott Hamilton : *Byzantine Architecture and Decoration.*
A. W. Clapham : *Romanesque Architecture in Western Europe.*
English Romanesque Architecture before the Conquest.
English Romanesque Architecture after the Conquest.
Francis Bond : *Gothic Architecture in England.*
Introduction to English Church Architecture, 2 vols.
J. H. Parker : *An Introduction to English Gothic Architecture.*
C. E. Power : *English Mediæval Architecture.*
M. and C. H. B. Quennell : *Everyday Life in Saxon, Viking, and Norman Times.*

PART V.—GOTHIC ARCHITECTURE

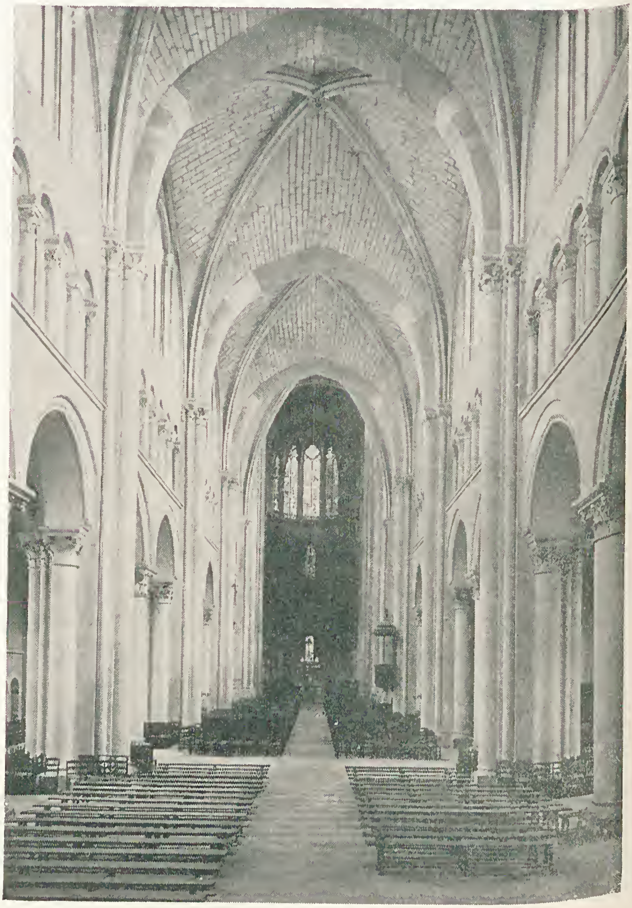
FRENCH GOTHIC ARCHITECTURE

GOTHIC architecture arose in France during the second half of the twelfth century as a result of gradual development based on two fundamental principles: (*a*) the concentration of strains upon isolated points of support, and (*b*) the balancing of one system of thrusts by another. The first of these was but a further development of the Roman method, but the second gave rise to an elastic system different in essence from the normal inert stability of Roman construction, in which thrusts were resisted by great masses of material.

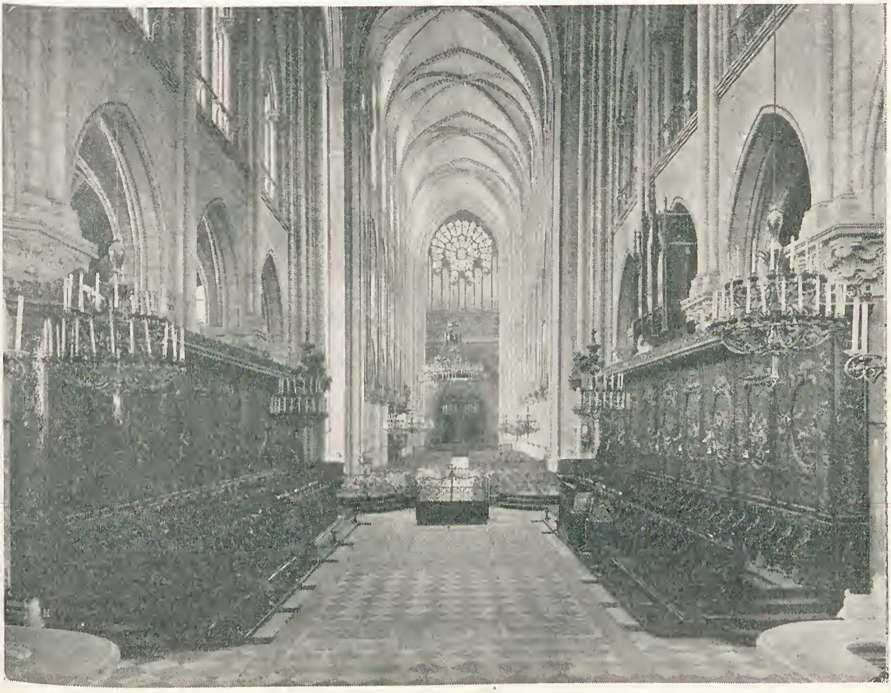
The Use of the Pointed Arch and Ribbed Vaulting

Important factors in the Gothic scheme are the use of the pointed arch and ribbed vaulting. The latter is fundamentally different from the unribbed vault, as in ribbed vaulting the curvatures of the ribs are the deciding factor, whereas in unribbed vaults the line of the groin is merely the intersection of predetermined vaulting surfaces.

It has been explained that in Romanesque work the vault was usually in square bays, one square of the nave to two of the aisle, and that the piers were often alternately heavy and light. As a pointed arch could reach to any height greater than half its



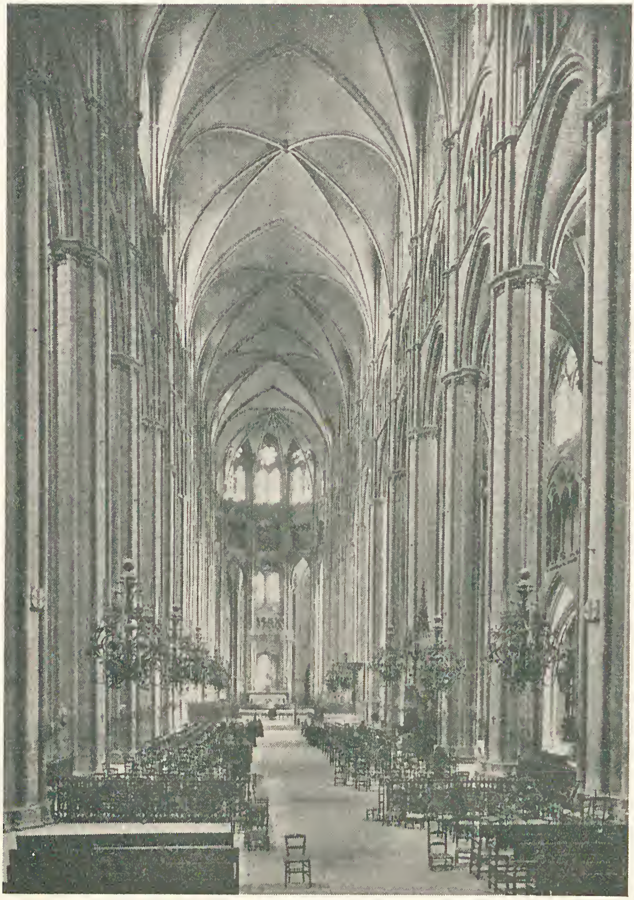
LE MANS CATHEDRAL—THE NAVE



NOTRE-DAME, PARIS—INTERIOR OF NAVE

span, oblong bays became normal, one bay of the nave fitting in with one bay of the aisles, and all the piers could be made similar. In later Romanesque times the pier was often circular in plan, and in early Gothic a single shaft was attached to the side facing the nave, but gradually the fully developed pier was achieved with a shaft on each of its four faces. It will also be noted that with the use of the pointed arch the great difficulty experienced in vaulting the awkward shapes of the passage-way round the apse was readily overcome, but it will also be seen that the French Gothic designer still stilted the apse arches, preferring to retain a normal curve rather than an acutely pointed one.

In plan, the French Gothic cathedral consists of a nave and chancel with aisles, frequently with double aisles, the church thus being very broad for its length, a breadth increased still further by the practice, usual in later Gothic in France, of including inside the church the spaces between the boldly projecting buttresses. Transepts are usual, but though the double transept apparently had its origin in Cluny it was more usual in England than in France, and, owing to the great breadth of the church, transepts project less from the body of the main building than in England. At the east end was the apse, with its passage-way or ways,


BOURGES CATHEDRAL—THE NAVE

and its radiating chapels, the whole scheme of the chevet reaching its maximum development in Le Mans Cathedral.

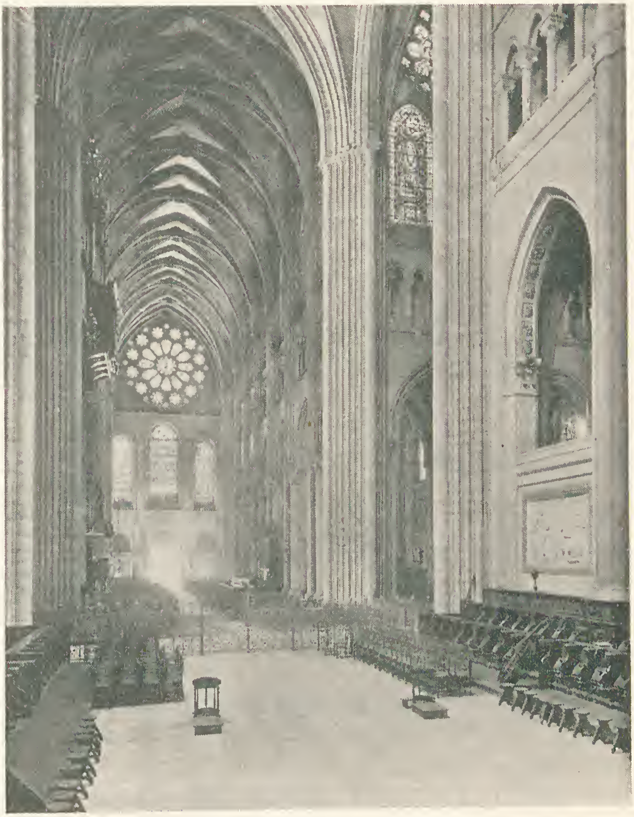
The way in which the slender but boldly projecting buttress takes the place of the thick wall and broad, flat buttress of Romanesque times can be well seen in the cathedral at Troyes, and perhaps even better in the church of S. Urbain in that town. These buttresses are, of course, connected to the nave vault by means of flying buttresses.

In dealing with French Romanesque architecture, it was pointed out that at the abbey church at Vézelay the nave of the early years of the twelfth century was covered with a semicircular groined vault, the load being thus concentrated on definite points, and windows obtained high up near the top of the vault. It was also shown that the ante-chapel of the same church was covered with a groined vault of pointed form, but still without groin ribs.

At Le Mans, in 1158, alternately heavy and light piers were used, the lighter ones fitting in with the smaller divisions of the aisle vault, while the great piers were carried up to take the ribs of the main vaults, which are arranged over square bays with pointed arches and groin ribs, a scheme which ultimately allowed of the use of great windows between boldly projecting buttresses.

It has also been pointed out that at the Abbaye-aux-Dames at Caen,

while still keeping to the square plan, the size of the vaulting spaces was reduced by placing across the middle of each bay an intermediate rib carrying a vertical wall to support the centre of the vault.



CHARTRES CATHEDRAL—THE NAVE

In other cases, as at the Abbaye-aux-Hommes at the same town, and as at Sens, this idea was carried a step further, the vaults being brought down to the intermediate rib to give the sexpartite form of vault. At Sens the main vault ribs are brought down to the floor by means of shafts in front of the main piers, but the shafts from the intermediate ribs stop on the tops of the capitals of the coupled columns forming the intermediate piers.

At Notre-Dame, Paris, practically finished by 1214, a pointed sexpartite vault was used, intermediate piers were abandoned, and circular columns were used throughout. These circular columns, popular during this intermediate stage, had distinct practical advantages, and the necessary stopping of the vault shaft on the top of the capital is their only weak point æsthetically.

The vast cathedral at Bourges may be taken as one of the greatest examples of incompletely developed Gothic. Its plan is remarkably fine, and, like most fine plans, particularly simple, consisting of a great nave, with double aisles passing right round the eastern apse, while at the west end there are five magnificent entrances. Internally the inner aisles have practically the proportions of an English cathedral, while the great nave arcade, the brilliant clerestory, and the vast sexpartite vault make up a most impressive *tout ensemble*.

It was next realised that with the pointed arch the sexpartite vault, as also the square compartment, could be abandoned, and a pointed, groined vault could be placed over a rectangular slice of the nave equal in width to a bay of the aisle. This was carried out at Noyon, but here alternate piers are still retained, with shafts stopping in the capitals of the lighter ones.

At Soissons the scheme is carried a step further, for here is the complete Gothic quadripartite vault ; all piers are alike, and the vault ribs are brought down to the floor, but this latter point is only carried out in a somewhat tentative fashion.

Fully Developed Gothic Scheme

Chartres Cathedral was one of the first in which the fully developed French Gothic scheme was worked out, with pointed quadripartite vault on oblong bays, with all piers similar. At Amiens, which was rebuilt in 1270, the scheme is almost perfect.

Reference has been made to the general arrangement in section of the cathedral at Bourges. At Amiens a further development was made, as here the triforium is glazed, an arrangement made possible by constructing the roof of the aisle as a series of pyramids, while at Beauvais, a somewhat similar scheme was developed to the extreme limit of verticality and slenderness possible to Gothic architecture in stone.

In the exteriors, towers form an important part of the design, but so tall were the naves that in many of the leading cathedrals the towers were barely able to dominate them, and it was practically impossible to construct a central tower, and the need for emphasis at the crossing led inevitably to the use of a slender *flèche*, as at Amiens.

At the west end the most striking features were the vast portals, as at Bourges, Amiens, and Rheims, compared with which our English western doorways appear trifling. On the other hand, our great western windows compare very favourably with the French circular ones, which are also used in the transepts, and, as has already been suggested, certain of our cathedrals score heavily by reason of the manner in which their western towers dominate the more modest nave roof, and are in turn dominated by the central tower. At the east end the typical square façades of the English cathedrals are a remarkable contrast to the French chevet, with its complicated scheme of apse, passage-way, chapels, and flying buttresses.

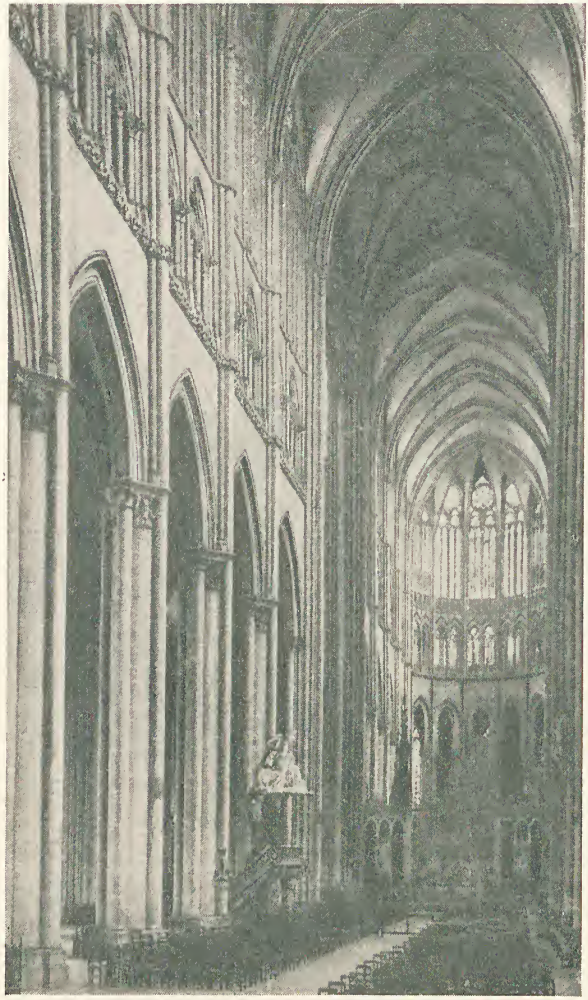
Windows

At the beginning of the thirteenth century, windows were normally somewhat similar to English lancets, but as was the case generally in the Gothic period, but not in the Renaissance, somewhat broader. Such openings were arranged singly, in pairs, or in larger groups, as may be seen in the cathedrals of Noyon, Soissons, Sens, and Vézelay. When two

AMIENS CATHEDRAL—EAST END
Note the *flèche* at crossing of the nave.

such windows were arranged side by side under a containing arch, and the space above the windows was pierced, the beginnings of tracery resulted, and as the general appearance was that of an opening pierced through a slab of stone, this type is known as "plate" tracery, to distinguish it from the later "bar" tracery, in which the solids between the openings have the same section as the mullions. Bar tracery is, however, much more common in England than in France. At first, French tracery was particularly simple, but gradually foliations were introduced.

At Notre-Dame, Paris, may be seen the typical window of the thirteenth century in France, consisting of a large circle above two lancets, all formed in bar tracery inside a pointed arch, the springing level of which is approximately at the level of the apex of the two lancets. At Auxerre are similar windows, but with foliations in the large circular opening, the foliations turning not toward the centre, but away from it. During the fourteenth century there was comparatively little further development of tracery in France, tracery of a geometrical type being used, but not developed to such an extent as in England, and the English development

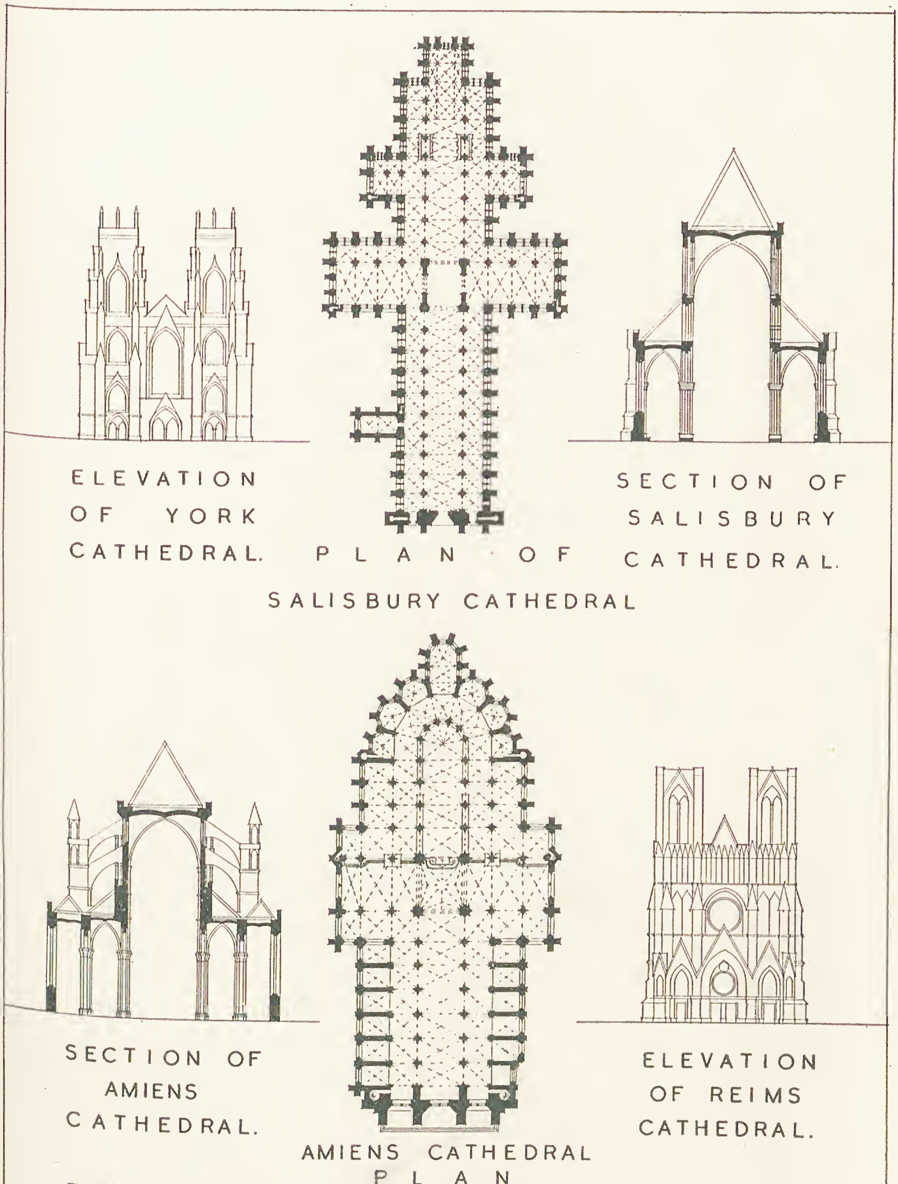


AMIENS CATHEDRAL, THE NAVE

of flowing lines did not occur at this time in France. During the fifteenth century, when in England flowing lines were abandoned in favour of rectilinear ones, in France the flowing line became popular, and in late French Gothic, or Flamboyant, the curved forms in tracery and other features became elaborated to a remarkable extent. If this development owes anything to the English Decorated work of the fourteenth century it is a subject on which we should boast with care, as none of the elegancies, daintinesses, and intricacies of late French Gothic can compare with the great direct architecture of the earlier period. Of this late Gothic in France the church of S. Maclou at Rouen may be quoted as a good example.

Capitals

It has been shown that French Romanesque piers were often square on plan, sometimes with the addition of rectangular projections on two or four faces, and sometimes with a semicircular shaft going up to the vaulting. When alternately heavy and light piers were used, the light ones were often circular, and this type became common in the early part of the Gothic period, developing into a pier with a shaft on each of its four faces. The capitals of the piers in the Romanesque period were based on the classic Corinthian, gradually changing from this to the capital of crocket type of the main Gothic period.



ENGLISH AND FRENCH GOTHIC ARCHITECTURE

RHEIMS CATHEDRAL—WEST END
The most striking feature is the vast portals.

Later Gothic Developments—the Flamboyant Style

In later Gothic the ornament of the capital, along with other ornament, tends to become more naturalistic, but not to the extent of that development in England. In the Flamboyant period the ornament changes back to the conventional, but of a curiously exaggerated and long-drawn-out type, while in some cases in this period circular columns have no capitals.

French mediæval mouldings are at first vigorous, and retain the main rectangular outline of the original offsets. These mouldings tend steadily to increasing elaboration, but without the undercutting common in early Gothic in England, while in the Flamboyant style the mouldings are, like the ornament, curiously drawn out.

The use of interpenetration—a sign of decreasing vigour in design, but of increasing facility in execution—which became very popular in Germany, is but rare in France, and probably even more rare in England.

Gothic Work in the South of France

Strong classic tradition and the possibly equally strong influence of climate led to a style of Gothic work in the south of France totally different from that in the north, and no statement on French Gothic architecture as a whole would be complete without some reference to it. Albi Cathedral may be taken as typical of this southern Gothic. It is an aisleless building, with slender windows and broad masses of brick walling, and all that show externally of the buttresses are flat segmental projections; in fact, a type of building more different from the typical French Gothic, and yet built at the same time and in the same country, it would be difficult to conceive.

ENGLISH GOTHIC

English Gothic architecture was in certain particulars more modest than that of France. It was also less clear-cut and logical, but in this connection it must be remembered that most English cathedrals—Salisbury is a notable exception—exhibit the different styles of numerous periods. It is, in fact, partly for that reason, if partly because of the literature of the Gothic Revival, that the fine structural qualities of Gothic architecture are too often in England confused with the picturesque qualities of ivy-clad ruins.

The Cathedral Plan

The English Gothic cathedral plan is comparatively long and narrow, the double aisles common in France not being used, and for this reason transepts of no greater length have a much bolder projection, particularly in the lower part of the building. While the double transept appears to have been used for the first time at Cluny in Burgundy, the idea was not further developed in France, but the feature occurs in a number of cases in England.

SALISBURY CATHEDRAL—FROM THE NORTH-EAST

The regular side chapels common in France were not used in England, such chapels as were used at the side of the cathedral being in the nature of specially constructed projections.

Chapels were, however, provided on the east side of the transepts in certain cathedrals. In some cases there are aisles on both east and west sides, and in others only on the east side of the transepts.

At the east end the chevet and other apsidal schemes introduced in the Norman period were abandoned, and the square east end used in various examples of Anglo-Saxon churches was reintroduced.

The narthex, which played such an important part in the French cathedral—particularly in Burgundy—is practically unknown in England—traces of it, however, are to be found in the form of "Galilees," as certain western porches are called. On the other hand, porches arranged at the flank of the building, sometimes off the north aisle and sometimes off the south, are important features of the English church.

The western entrances to English cathedrals, as has been mentioned, are far smaller and less impressive than those in French cathedrals.

Vault Developments

In the early part of the thirteenth century the typical English vault was formed with pointed arches over a rectangular compartment, with no ribs other than wall ribs, transverse ribs, and diagonal ribs. The ridge was kept horizontal, the domical type of vault common in France

not being used. Occasionally, in order to increase the size of the windows, the transverse ridge actually rises toward the wall. The diagonal ribs reaching to a greater height than the other ribs, in France the courses of stone forming the severies or infilling were tapered, so that the top course fitted along the ridge. In England, however, these courses were made approximately parallel and at right angles to the line bisecting the angle of the panel of the vault, with the result that at the top there is no single course fitting along the ridge, but a number of courses which meet it at an angle. The courses span in arched form from rib to rib; in early vaults these courses run over the back of the ribs, but in later work they rest on rebates formed in the ribs.

In order to increase the width of the clerestory windows the wall ribs were sometimes stilted, giving a vault with a twisted surface, known as a ploughshare vault, or vault with ploughshare twist.

In the later part of the Early English period (1175–1275), additional ribs, called tiercerons, were introduced. These ribs started at the springing level and reached the ridge, and decreased the size of the infilling. Where such ribs are used, ridge ribs are required. Ridge ribs became common in England, and were useful, not only to take the thrust of the tiercerons, but also to mask the intersections of the infilling at the ridge.

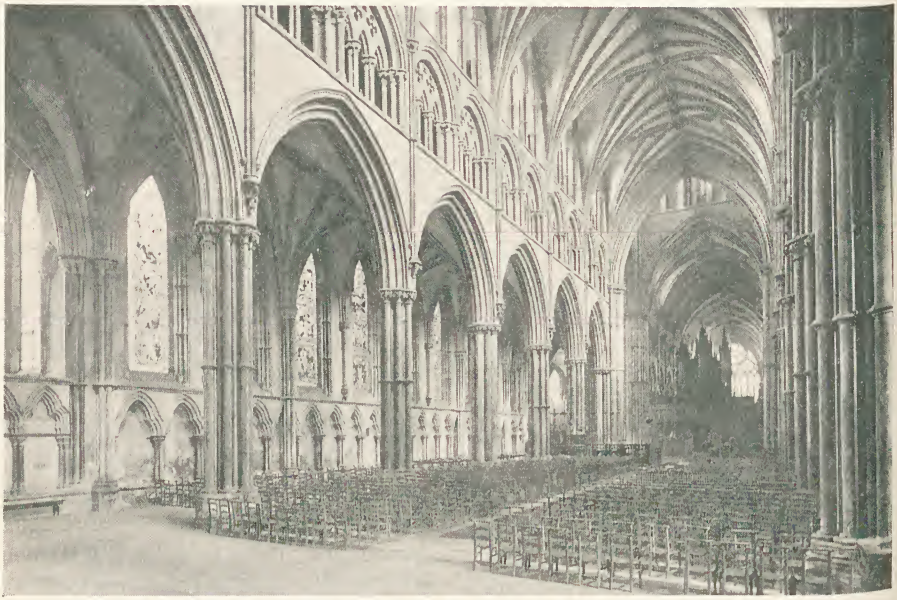
In France, tierceron ribs being rare, the ridge ribs were but seldom used; the more careful jointing of the infilling made them unnecessary, and as a matter of fact, their use would have emphasised unduly the rise and fall of the ridge in the customary domical vaults.

Early tierceron ribs were arranged to fit in with the surface of the vault, but later it was seen that they could be used—similarly to the diagonal ribs—at the intersection of two vaulting surfaces. This realisation led to a considerable increase in the number of ribs, and to a horizontal section through the vault being polygonal instead of rectangular. An excellent example of this type of vault is to be found in the nave of Exeter Cathedral.

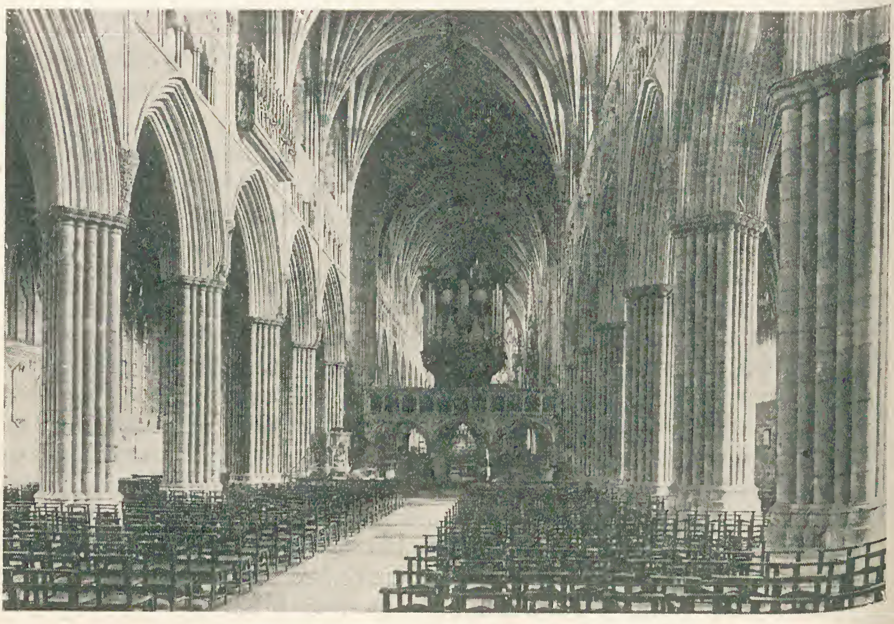
During the Decorated period (1275–1375), the number of tiercerons increased, and additional ribs, not starting from the springing, but crossing the surface of the vault, gave star-shaped forms on plan, and vaulting of this type was consequently known as stellar vaulting.

The lower part of a ribbed vault, known as the *tas-de-charge*, was built as a corbel, with horizontal joints, until the point is reached at which all the ribs are quite separate. At the intersections of the ribs, keystones or "bosses" were formed with an arm reaching out in the direction of each rib, while later each boss included a portion of the infilling on each side.

As the tiercerons increased in number the amount of infilling was steadily reduced, until the point was reached when the ribs were no longer separate arches holding up the infilling, but the infilling and the ribs were all worked on the same stones. This was a fundamental change, a return



LINCOLN CATHEDRAL, SHOWING THE NAVE, LOOKING EAST



EXETER CATHEDRAL—THE NAVE, LOOKING EAST

being made to the Roman method of vault design in which the surface and not the rib is the determining factor. The new type of vault, known as fan vaulting, consists of a series of ribs formed on the surface of a set of inverted concave semi-cones. Pendant vaulting was a further development, in which arches, sometimes above the vaulting surface and sometimes exposed, supported a series of pendants.

These vault developments, lierne, fan, and pendant, were rarely used in France, and in this the French were probably right. The simpler form of vaulting is more satisfactory in design, and the later examples, with their greater elaboration, are not indications of an advance in design, but rather of that development of technical efficiency which seems to occur as an anti-climax after a period of fine design.

Roofs

It should be noted that only the more important churches in England were vaulted, the others being covered only with a roof. In some examples the roof was ceiled, but in the majority of cases the roof timbers were exposed to view. Early in the Gothic period the normal roof was formed with rafters, braces, and collars spaced from 1 ft. to 2 ft. apart, and frequently ceiled. In order to prevent the roof from exerting excessive thrust on the walls, tie-beams spaced about 8 ft. apart were used from quite early times. These ties were often cut with a camber, and in some cases arched braces were used below them. During the mid-period of English Gothic, horizontal timbers high up the roof were supported by braces in the form of arches. Toward the end of the fourteenth century the hammer-beam roof was introduced. In this type the horizontal sole-pieces were projected forward and supported on curved brackets, a special development being the type used for Westminster Hall, in which the principal member is a great timber arch.

In successfully designed roofs of the open timber type, timbers of considerable thickness are used throughout, the trusses are connected by means of arched brackets at intervals, and longitudinal braces are used on the under surface of the roofs.

The flat roofs common in late Gothic were frequently formed by means of tie-beams, often with brackets or arched braces below, spanning the aisle or nave, supporting longitudinal timbers which carry the roof boarding.

Interiors

The interiors of the English cathedrals are more modest in height than those of France; actual heights being : Westminster 102 ft. and Salisbury 84 ft., against Beauvais 150 ft. and Amiens 144 ft. The general scheme of the English cathedral interiors is also much simpler than those of France,

having only single aisles, while such complications as the glazed triforium are unknown.

The general tendency in the treatment of the nave arcade, triforium, and clerestory was the gradual reduction of the importance of the triforium. This was first brought about by using two main arches in the triforium over one in the nave arcade, but in later work the openings were omitted altogether, and the intervening space between nave arcade and clerestory was panelled, being still further reduced in size by the use of flat roofs to the aisles. A further step is taken in Canterbury Cathedral, where the nave arcade includes the triforium and clerestory, the piers directly supporting the vault, a fact which is normally less well indicated in English Gothic than in French.

Development of Windows

The development of the window was at first somewhat similar to that in France. The single lancet, then two or three lancets grouped under a containing dripstone, and then the piercing of the space between the lancets and the dripstone to form plate tracery, was the normal development, though the latter stage had been anticipated at the church of St. Maurice in York in the late Norman period. Plate tracery has the appearance of being pierced in a slab, and differs considerably from bar tracery, in which the solid parts have the same cross-section as the mullion. During the Early English period, bar tracery in simple geometrical patterns gradually became normal, while during the fourteenth century more flowing forms were used, the ogee curve being frequently used for sub-arches and less frequently for main arches. In the Perpendicular period, curved lines in the tracery—except the very simplest—are gradually replaced by vertical mullions. As this style develops, the main arches are often of flattened—four-centred—type, and toward the end of the Gothic period the window with a flat head is not uncommon, at first with cusped sub-arches, then with sub-arches without the cusps, and finally without sub-arches. It may also be noted that during the whole period of Gothic architecture in England there is a gradual development of the size of the main windows, and a reduction in width and increase in projection of the buttresses, until in late Gothic the supporting wall may be considered as being placed in short lengths at right angles to the side of the building, where it can best resist the thrust of the vault or roof, while the spaces between the buttresses were filled in with windows in the upper part and with light screen walling in the lower part.

It may also be noted that in this late period there was a tendency to place the arch of a doorway in a rectangular frame, and this fact, together with the form of the tracery and the flattened type of roof, tends to give a rectilinear appearance to the buildings which was a fitting development in view of the great changes which were to come from the Continent during the Tudor period.

Piers

WESTMINSTER ABBEY, HENRY VII CHAPEL

Piers of the Early English period were frequently enriched with slender shafts of Purbeck marble, while the capital had an abacus curved on plan and on edge, a concave bell, and frequently ornament of the stiff-leaf variety. In the fourteenth century the piers had no detached shafts, these being abandoned owing to frequent failure, the capital had a scroll-moulding abacus curved on plan, but the foliage became more naturalistic, and had the general appearance of being wrapped round the capital rather than of giving support to the abacus. In later Gothic, piers were often wider from north to south than from east to west; the capital did not go all round the pier in many cases, but was only applied to attached shafts on the cardinal faces, while ornament in the capitals was normally in separate square shapes, and generally tended once more to the conventional rather than the naturalistic.

Mouldings

Early English mouldings are deeply undercut, giving strong effects of light and shade, and during this period the general shape of the Norman rectangular offsets was more or less retained. The tendency, as the style develops, is for the undercutting to be reduced and for the rectangular outline to disappear, until finally the mouldings are very shallow and are arranged on a chamfer plane.

Mediæval Town Planning

It is often assumed that, during the Middle Ages, there was no deliberate town planning, but that more or less haphazard development

MAGDALEN COLLEGE, OXFORD

took place inside the limits laid down by the town walls. Some go to the opposite extreme, and hold that what is apparently haphazard is really the result of careful design.

It should also be borne in mind that, during this period, certain towns, such as Montpazier, were definitely laid out in an orderly fashion closely following the methods adopted in Roman times.

REFERENCE BOOKS

Sir Banister Fletcher: *A History of Architecture on the Comparative Method.*
F. M. Simpson: *History of Architectural Development*, Vol. II.
Francis Bond: *Gothic Architecture in England.*
Introduction to English Church Architecture.
W. R. Lethaby: *Mediæval Art.*
Sir T. G. Jackson: *Gothic Architecture in France, England, and Italy.*
W. H. Godfrey: *Story of Architecture in England.*
Cyril E. Power: *English Mediæval Architecture.*
C. Ward: *Mediæval Church Vaulting.*
Howard: *Mediæval Styles in the English Parish Church.*
E. S. Prior: *History of Gothic Art in England.*
A. Pugin: *Examples and Specimens of Gothic Architecture.*
R. and J. A. Brandon: *Analysis of Gothic Architecture.*
Open Timber Roofs of the Middle Ages.
T. F. Tout: *Mediæval Town Planning.*
M. and C. H. B. Quennell: *History of Everyday Things in England*, 1066–1499.

PART VI.—RENAISSANCE ARCHITECTURE IN ITALY, FRANCE, AND ENGLAND

THE great movement known as the Renaissance, which arose in Italy during the fourteenth century, affected all realms of thought, and influenced profoundly all the arts in general, while in particular it resulted in remarkable changes in the art of architecture. In essence it was a return for inspiration to the classic sources—Roman in the main, but Greek as well as Roman. For such a "rebirth," Italy was the inevitable scene, and it may be noted from the point of view of architecture that not only was Italian mediæval architecture far less changed from the classic than was that in Germany, England, or France, but in Italy, to a far greater extent than elsewhere, Roman, and in some areas Greek, models were available.

It was during the fifteenth century that the change first shows in the architecture of Florence, and while it is only this early work which is, strictly speaking, Renaissance architecture, most English architects have tended to use this term to cover all architecture from the close of the Gothic period to the Gothic revival. It should also be borne in mind that until quite recent times it was only this early work which was considered worthy of praise, though during the present century the good points of the work of the later periods have been increasingly appreciated.

The Work of Brunelleschi

In the year 1403, Brunelleschi, having failed to win a competition for the new doors for the Baptistery of Florence, went to Rome with young Donatello and studied the design and construction of Roman buildings. Returning to Florence in 1407, he subsequently played an important part in the architectural development of that city, being responsible for the dome of the cathedral, the churches of S. Spirito and S. Lorenzo, the Pazzi Chapel, and with Michelozzo for the Riccardi and Pitti Palaces.

The churches are somewhat on the lines of the Early Christian churches, using columns to support arches, with a slice of entablature taking the place of the Early Christian dosseret. In the church of S. Lorenzo, in particular, should be noted the relationship between the nave arcade and the wall treatment. The Pazzi Chapel is an exquisite piece of design, worthy of the closest possible study, particularly in the interior, with its square chancel covered with a dome on pendentives; and an oblong nave, with the square, central part having a dome on pendentives, while the portion on each side is covered with a barrel vault. The relationship of the wall pilasters to the vaults and dome should be carefully noted.

The palaces show the effect of classic influence mainly in the strength of the horizontal line, particularly in the powerful cornices with which they are crowned. The treatment of the masonry is also noteworthy :

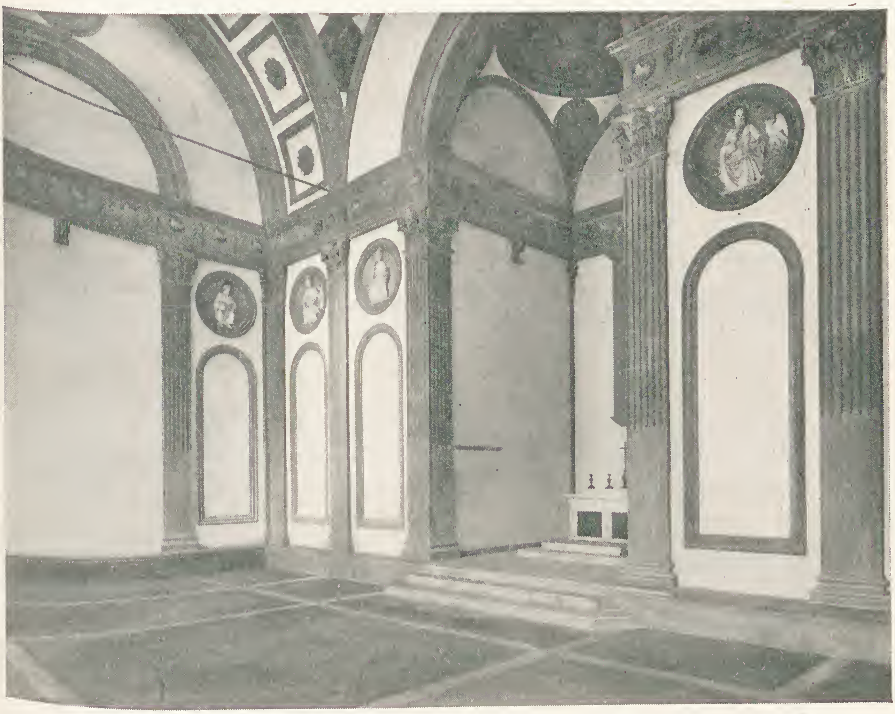
RICCARDI PALACE, FLORENCE
Classic influence is mainly shown in strength of horizontal line.

in the case of the Riccardi Palace the lower storey is powerfully rusticated, the middle storey is treated with rebated joints, while the top storey is of plain ashlar. The great size of the stones used should be noted with care, as should the general scale of the building. In the case of the Pitti Palace it is difficult to realise that the windows are as much as 24 ft. from centre to centre.

Alberti and Bramante

Brunelleschi died in 1446, and shortly after that date Alberti (1404–72) designed the Rucellai Palace, in which each storey has its own order, the intermediate entablatures being wisely reduced in size in order that the top one may adequately dominate them—a problem which had aroused the interest of the designer of the top storey of the Colosseum over 1,000 years earlier. Alberti's church of S. Andrea at Mantua marks, in its plan, with its alternate chapels and bold piers in place of the rows of columns, a great development from Brunelleschi's ecclesiastical work. This plan, in fact, forms the basis for much subsequent design.

Of the Roman school, Bramante (1444–1514) was one of the leading architects in the early days. His work is first in the manner of the early Renaissance, as, for instance, the church of S. Maria della Grazie, Milan, and the sacristy of the church of S. Maria near San Satiro, Milan. In these buildings may be found typical early Renaissance detail, such as pilasters with delicate arabesques, niches with semi-domes of shell form, etc. His



INTERIOR OF THE PAZZI CHAPEL, FLORENCE
An exquisite design, worthy of the closest possible study.

Tempietto in S. Pietro in Montorio, Rome, is more definitely classic, but it should be remembered that it is a monument erected in memory of an incident of classic times. Another of his later buildings is the Cancellaria Palace, Rome, in which he used a typical feature, round-headed windows framed in a square, while the pilasters used on the two upper storeys were arranged with narrow and wide spacings alternately.

Peruzzi, Sangallo, and Michel Angelo

Peruzzi (1481–1536) is well known for his well-planned and delicately detailed Massimi Palace, Rome, and for the Farnesina Palace, in the same city, with projecting wings (an unusual feature in the Italian Renaissance), and with windows formed in the frieze. His Palazzo Albergati at Bologna is remarkable for its Egyptian-like plinth, its fine wall surface, and for the fact that the orders are used only to the ground-floor doorways and the first-floor windows. The Farnese Palace, Rome, was designed by Antonio Sangallo the Younger (1485–1546), with the exception of the top storey, for which the great Michel Angelo was responsible. It is a fine piece of work with an excellent concentration of interest about the

FARNESE PALACE, ROME

A fine piece of work designed by Antonio Sangallo the Younger. Michel Angelo designed the top storey.

central doorway and the window over, a good vestibule, a cortile reminiscent of classic Roman work in its lower storey, and a façade which owes much to Michel Angelo's top storey, with its interesting window treatment and excellent cornice. The weak point of the design is the nearness of the windows to the corner of the building. Among other works by Michel Angelo may be mentioned his famous Medici chapel in S. Lorenzo, Florence, and the palaces on the Capitoline Hill, Rome.

Vignola

Vignola (1507–73), who was followed by the French much as Palladio was followed by the English, was responsible for a number of important designs, each of which has a strong claim to originality. Among these may be mentioned his Villa for Pope Julius III, with a semicircular cortile, his pentagonal castle of Caprarola with a circular court, and the chapel of S. Andrea, Rome, with an elliptical dome. His church of Il Jesu, with its well-proportioned if somewhat ornate interior, is of special interest for its plan, based on that of S. Andrea, Mantua.

The greatest work of the Roman school is, of course, the famous cathedral of S. Peter, Rome, built on the site of an Early Christian church. Among the architects who worked on the design of this structure were Guiliano da Sangallo, Peruzzi, Sangallo the Younger, Vignola, and Michel Angelo. The latter left drawings and models for the completion of the dome, which was erected by Giacomo della Porta and Fontana. Maderna

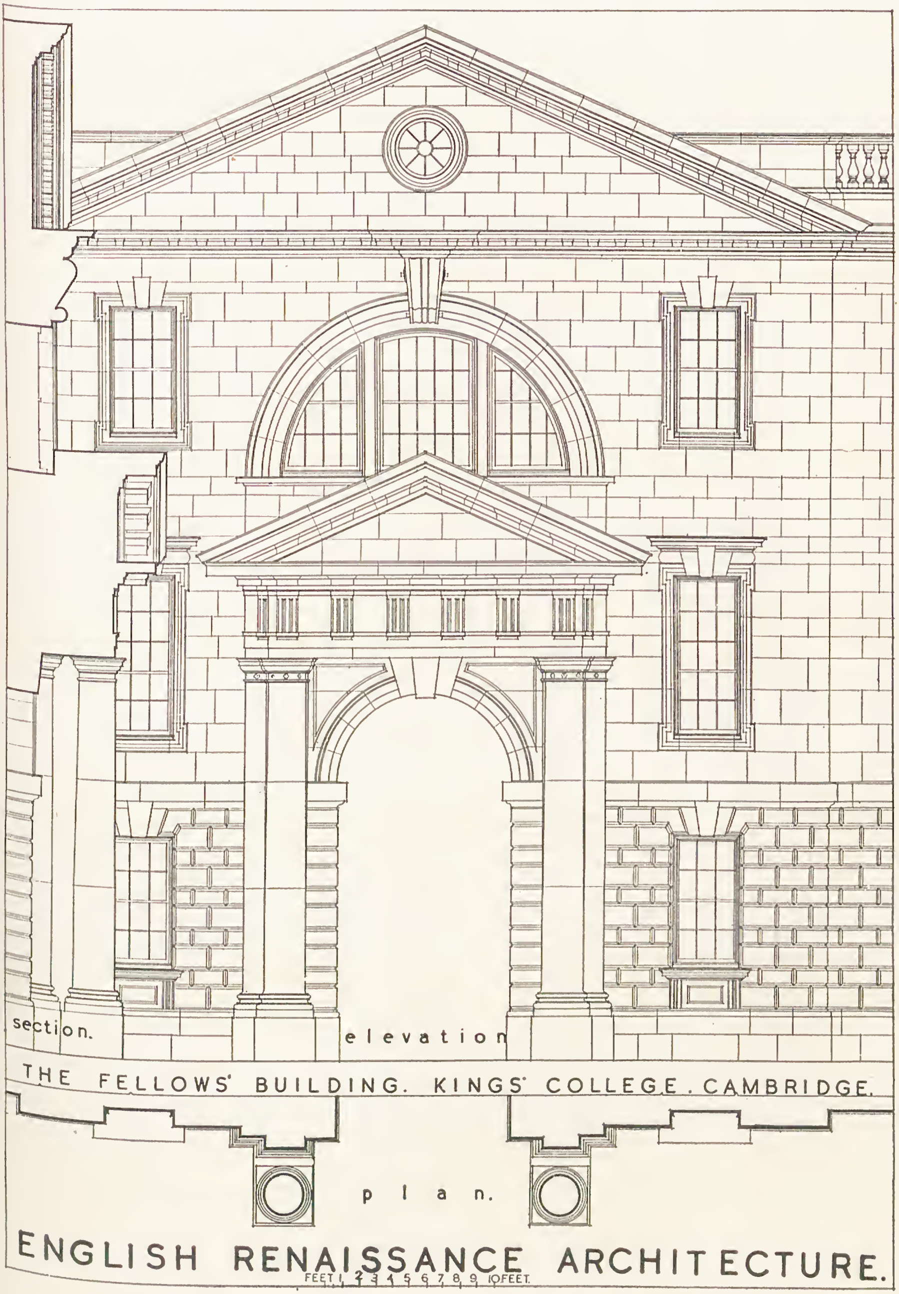
ST. PETER'S CATHEDRAL, ROME—VIEW BENEATH THE DOME

lengthened the nave in the early years of the seventeenth century, while Bernini was responsible for the magnificent colonnade which leads up so finely to the west front. The dome is noteworthy both for its vigorous exterior and for its dramatic effect in the interior. The student who wishes to get an idea of the scale of S. Peter's should plot the plan of one of its dome supports on the plan of a building with which he is familiar.

The Early Days of the Renaissance in Venice

In the early days of the Renaissance in Venice, work of an interestingly free description was accomplished in the courtyard of the Doge's Palace, the School of S. Mark—which has some examples of the perspective treatment which was very popular at the time—and in a number of palaces such as the Cornaro-Spinelli. The latter retains in its tracery the Gothic section of bar and the Gothic form of central opening; it also shows the typical grouping of windows toward the centre, while the interesting plan-shape of the balconies on the first floor is noteworthy. The Vendramini Palace, which is somewhat later, has tracery bars more classic in section and less free in elevation. The church of S. Maria dei Miracoli (1480) was designed by Pietro Lombardo, who was one of the leading architects of the early Renaissance in Venice. It has a somewhat un-

THE CHURCH OF SANTA MARIA DELLA SALUTE, VENICE


section.
elevation
THE FELLOWS' BUILDING. KINGS' COLLEGE. CAMBRIDGE.
plan.
ENGLISH RENAISSANCE ARCHITECTURE.
FEET 1 2 3 4 5 6 7 8 9 10 FEET.

fortunate exterior, but shows in its interior some of the most beautiful detail of the time.

Of the next period may be mentioned the work of San Michele, much of which is to be found in Verona, where he designed remarkably able gates through the town walls, and a number of palaces, such as the Palazzo Pompeii and the Palazzo Bevilaqua. The city side of the Porta del Palio, with its rustication of the masonry extending to the columns, and its continuous entablature supported over the arches by boldly projecting keystones, may be taken as a fine example of his vigorous work. His Grimani Palace in Venice, though highly praised by Ruskin, and stated by Anderson to be probably his greatest work, may have many excellent qualities, but it lacks the vigour and the imagination of his work in Verona.

Sansovino's Palazzo Cornaro della ca'Grande is noteworthy for its lower storey and for its carefully designed interior court. His Mint, adjoining the Library of S. Mark, has curious hoods to the windows on the first floor, columns rusticated by setting back complete courses, and a top storey which is too important to be an attic, while the cornice below it is too important otherwise. The Library of S. Mark, which, by the way, has windows in its main frieze, is in many ways a fine building, but suffers from an overcrowding of features in the upper storey. At the end of the Library remote from the Mint is the richly treated Logetta with its lovely sculptures—all from the hand of Sansovino.

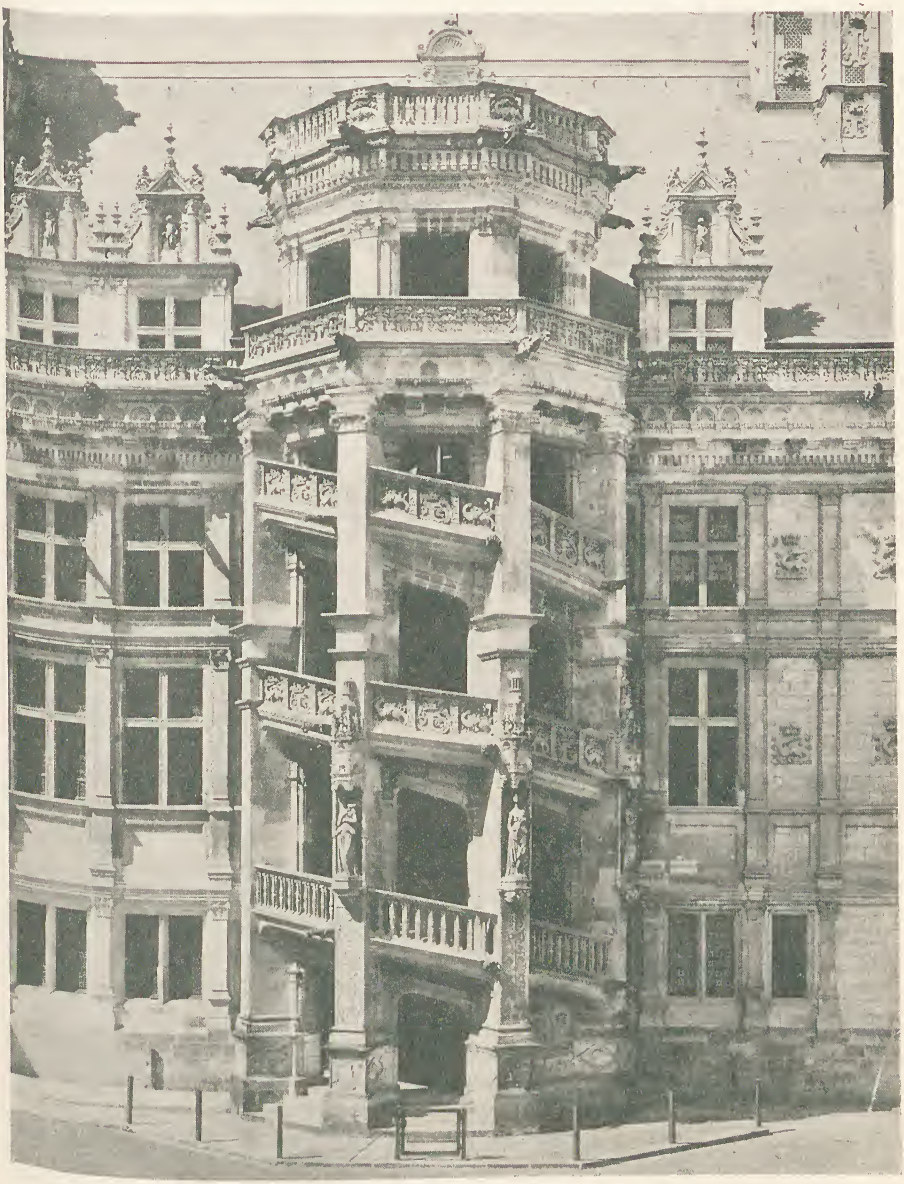
Palladio and Longhena

Palladio (1518–80), who was followed by English architects much in the way that the French followed Vignola, is best known for his work in Vicenza, where he designed a two-storey arcade to an existing Gothic building known as the Basilica, a number of palaces, a theatre, and the famous Villa Capra, which was reproduced in England by William Kent. He popularised the use of an order running through two or more storeys, and the feature known as the Palladian *motif*. His best-known work in Venice is the Chiesa del Redentore, with an interior which, notwithstanding the slightly theatrical effect of the curved screen of columns behind the altar, is full of dignity.

Baldassare Longhena (1604–75) was one of the outstanding figures of the seventeenth century, his S. Maria della Salute being probably the ablest work of the late Renaissance in Venice. Its exterior, with its fine lines leading the eye from the water's brim to the figure which crowns the cupola above the dome, is one of remarkable picturesqueness, in which the vigorously curved buttresses play an important part, while its octagonal plan is worked out with great skill.

FRANCE

Towards the end of the fifteenth century military campaigns in Italy introduced the French to certain aspects of the great new intellectual



THE CHÂTEAU, BLOIS
Showing the famous stair tower on the inner façade of the Francis I wing.

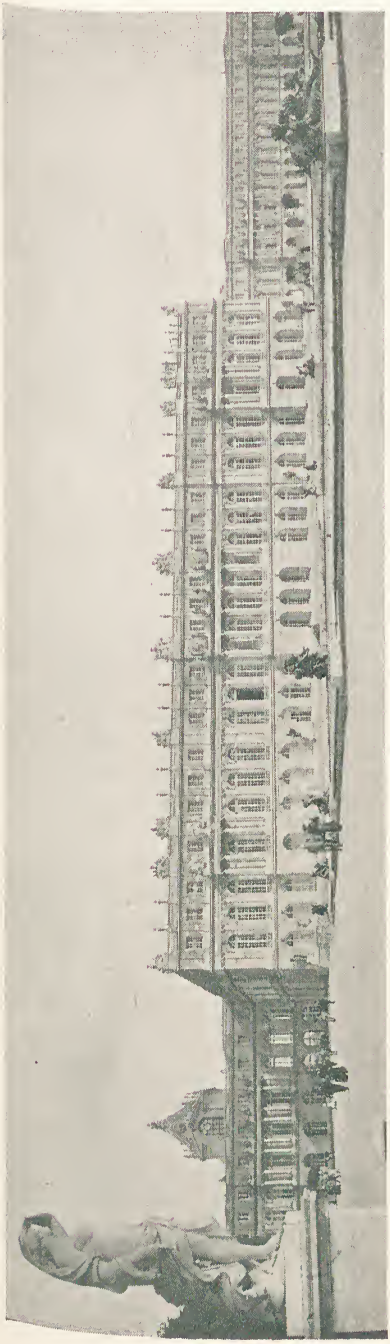
movement, and in particular to the important changes which were taking place in the art of architecture. The new ideas had a profound influence on French building, though at first the change was naturally slight, Gothic architecture being still full of vigour and vitality. In work of the time of Louis XII (1498–1515), the effect is seen principally in the strengthening of the horizontal line, and in the sculpture and ornament. As an example of this transitional work the Ducal Palace at Nevers may be taken, the stair tower of which is a particularly interesting specimen of the work of the time. The great château at Blois has an entrance front of this period, but the wing seen to the right on entering the courtyard, with its wonderful stair tower, is one of the finest examples of the time of Francis I (1515–47). Another fine building of the time of Francis I is the château of Azay-le-Rideau, an excellent, sturdy piece of work with ornament of great refinement most judiciously used. The buildings of the time of Louis XII and Francis I retain many of the features of mediæval structures, such as stair towers, and other towers and turrets, mullioned and transomed windows, steep roofs with dormer windows and bold chimney stacks, the old ideas dying hard. In fact, indications of some of these features are to be found right through the Renaissance in France, giving it an effect totally different from that of Italy. New features, mainly in the form of delicate pilasters at the sides of the windows, gradually emerged and were assimilated during the time of Francis I.

The Struggle between the Classic and the Gothic

During the reign of Henry II (1547–59), the rebuilding of the Louvre was started, and additions and extensions were made to this building right through the Renaissance period. Some idea of the vastness of the complete building may be gathered from the fact that it is practically half a mile in length.

The work in the south-west angle of the courtyard by Lescot, with Jean Goujon's sculptures, is one of the greatest achievements of the time of Henry II. The old freedom of treatment was gradually giving way to greater restraint, the classic orders were being used more extensively and more accurately, but the Gothic love of the vertical as contrasted with the horizontal still showed in the vertical emphasis given by the projecting pavilions.

During the early Renaissance in France secular work was of greater importance than ecclesiastical, but some interesting churches were built, including two well-known examples in Paris—the churches of S. Eustache (1532) and St. Etienne du Mont (1517–38). Like most church work of the time in France, these buildings are Gothic in all but detail. The west front of S. Michel, Dijon, may be noted as an example which shows clearly the similarity of the work of the early Renaissance to that of the still earlier Renaissance—for such it really was—of the Romanesque period.



VERSAILLES PALACE—BUILT DURING THE GREAT AGE OF CLASSIC ARCHITECTURE IN FRANCE

PLACE DE LA CONCORDE, PARIS

LUXEMBOURG PALACE, PARIS

Differing strikingly from the work of the Italian Renaissance because of the tall roof and sturdy chimney stacks.

Architecture during the First Half of Seventeenth Century

During the first half of the seventeenth century, French architecture was steadily becoming more classic, but in the later half of this fifty years a less formal influence from the Low Countries made itself felt. Of the more severe work may be mentioned the extensions to the château at Blois (1635–40), by F. Mansart, and the Luxembourg Palace, Paris (1615–24), by De Brosse, a stately piece of work in three storeys, strongly rusticated, but still retaining the tall roof and the sturdy chimney stacks beloved by the French, and differing strikingly because of these features from work of the Italian Renaissance. S. Marie at Nevers may be given as an example of the freer school. W. H. Ward, in his invaluable *French Renaissance Architecture*, says of its façade : " It is of so pronounced a Belgian Barocco type that it looks as if it had been transported bodily from Mechlin or Louvain and seems to postulate a Belgian architect."

The Period 1640–1715

The long reign of Louis XIV (1640–1715) was the great age of classic architecture in France, as it was a great period for France in other matters. At the same time there was a counter current of Barocco work, particularly in interiors.

Of the ecclesiastical work of the time, Les Invalides, by J. H. Mansart, stands out prominently. It is a great building, with a dome well linked to the lower supports, but the two storeys of the drum are too nearly equal, and its central supports are unfortunate : while the view of the upper dome seen through the eye of the lower dome is somewhat theatrical.

The secular work of the period is more characteristic, reflecting as it does the prosperity and power of France at the time. The great palace at

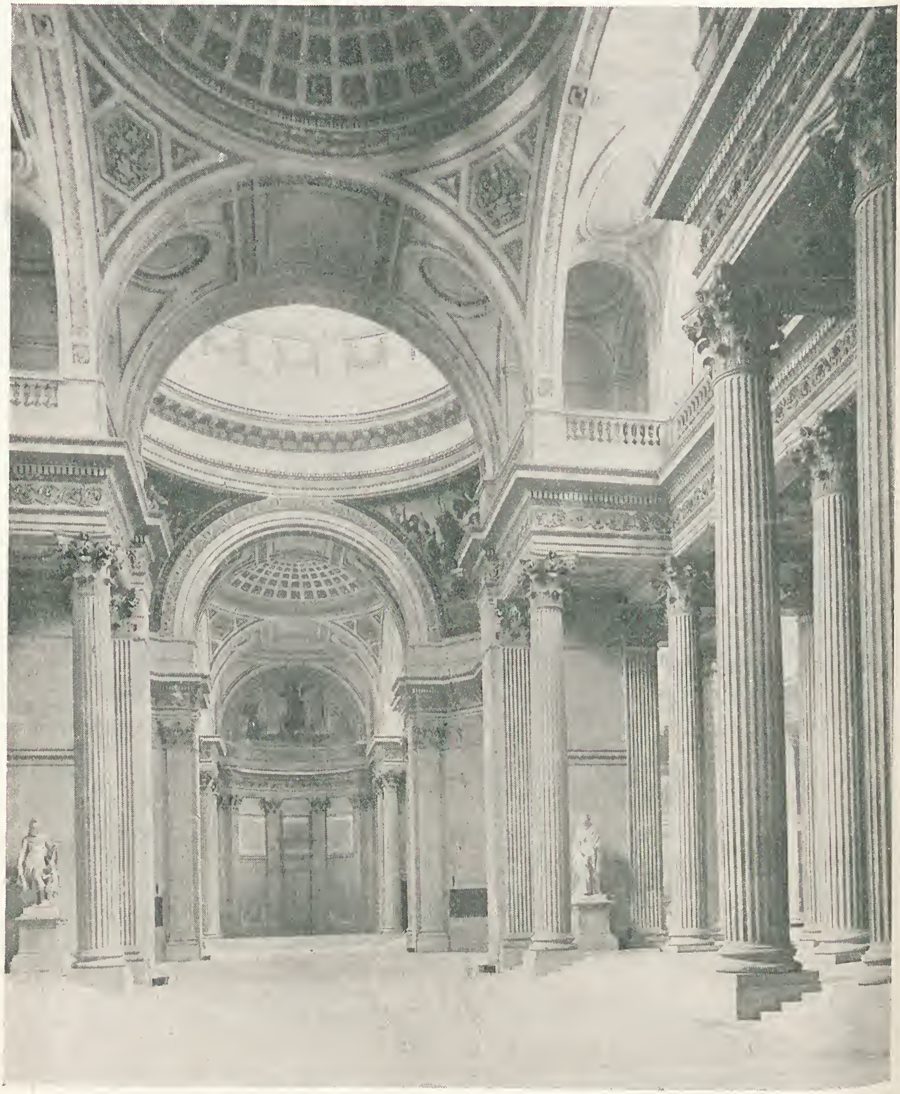
THE LOUVRE, PARIS, THE COLONNADE OF THE EASTERN FAÇADE
A composition of three primary masses with two connecting links.

Versailles, originally a fair-sized structure, was extended by J. H. Mansart to a building practically one-third of a mile in length, excellent in detail, well proportioned in features, but lacking adequate domination.

Less ambitious, but more successful, is Perrault's east front of the Louvre, a composition of three primary masses with two connecting links. Fortunately the attics originally designed for the end pavilions were not constructed, as otherwise the central pediment would not have dominated the façade adequately. The Château de Maisons, a very "French" building by F. Mansart, was described by Wren as "incomparable."

The Eighteenth-century Work

The long reign of Louis XIV was followed by the almost equally long reign of Louis XV (1715–74), during which there was once more a struggle between two rival schools. Of the monumental, academic work may be mentioned the west front of S. Sulpice, Paris, by Servandoni, and the Panthéon, also in Paris, by Soufflot. The latter building was daring in plan and in the slenderness of its construction, but lack of skill in workmanship resulted in the supports having to be strengthened, while the treatment of the drum leads to an apparent lack of connection between the



THE PANTHÉON, PARIS

An example of the monumental, academic work built during the reign of Louis XV (1715–74).

dome and the main building. Compare it with Santa Maria della Salute at Venice.

During this period there was a reaction against the formalities of court life, and this was reflected in the art of painting, and in an architectural movement mainly affecting interiors, in which an attempt was made to throw on one side all the rules of formal art and all the lessons of the past.

The experiment had been tried before and it has been tried since, but the French attempt in the eighteenth century, with all its defects, was noteworthy for the dazzling brilliance of its originality and for its grace and charm. This movement reached a point from which further advance on the same lines was impossible, and a return was made to the classic sources of inspiration, as may be seen in the Madeleine in Paris, by Vignon, and the Chamber of Deputies in the same city, by Poyet.

ENGLAND

During the Tudor, or late Perpendicular, period in England (1485–1558), the bulk of the building work was on traditional English Gothic lines, the strength of this tradition being shown by the entrance to Christ Church Hall, Oxford, built in the Gothic manner in 1640. In the late Gothic of the Tudor period, pointed arches tended to become flatter, and generally speaking the horizontal line was strengthened. Windows with horizontal heads were not uncommon, particularly in domestic work, and the sub-arches under the lintels are often without cusps. These windows usually have a "label" mould, and the typical mullion is hollow-moulded. In the eastern part of the country brick becomes a common building material. During this time, while there was no complete structure in the Italian manner, the Italian craftsmen who were in the country at the time appeared in some cases, as in the Salisbury Chantry, Christchurch, Hampshire, to have followed the English masons, and to have worked Italian ornament on available parts of a structure which is otherwise English Gothic. Similarly, in the Tudor part of Hampton Court Palace there are various items which are clearly Italian, such as the terra-cotta busts of emperors, the plaque of Wolsey's arms, and the details of the roof of the Great Hall.

Elizabethan and Jacobean Architecture

Unfortunately the Italians left England, and in the next period, Elizabethan and Jacobean (1558–1623), knowledge of the Renaissance in architecture came to us, not from Italy, or even from France, but from Germany and the Low Countries. During this period much of the work was still in the English tradition, and some critics look upon this simple, unaffected architecture, mainly domestic, of which much is to be found in the Cotswolds, as the best of the time. Unfortunately there was a lack of skilled designers trained in the new method of design, with the result that features new to the English craftsmen were applied without full understanding, and often in strangely incongruous association with mediæval features. Consequently no clear-cut style developed comparable to that of the early Renaissance in Italy or France, and the buildings of this period in England, while generally full of historic interest, and in many cases possessing such qualities as quaintness and charm, rarely reach a high level as sheer architecture.

THE BANQUETING HOUSE, WHITEHALL (1619–22)

Designed by Inigo Jones, who laid the foundations of a fully developed English Renaissance style.

Among the leading examples of Elizabethan and Jacobean architecture may be mentioned the Tower of the Schools at Oxford (with its superimposed orders), Aston Hall (with a typical plan in which the block across the front of the courtyard is omitted, and with an interesting stair leading to the usual long gallery on the first floor), Kirby Hall, Burghley House near Stamford, Burford Priory, Hardwick Hall, Bramshill, Haddon Hall, Hatfield House, and Holland House.

The foundations of a fully developed English Renaissance style were laid by Inigo Jones (1573–1652), whose achievement may be indicated by the Banqueting House, Whitehall (1619–22). His chances were ruined by the Civil War.

Sir Christopher Wren and the Eighteenth-century Architects

In a brief statement such as this it is quite impossible to do justice to such an architect as Sir Christopher Wren (1632–1723), who as a scientist would have been one of England's greatest men quite apart from his architecture. His Library for Trinity College, Cambridge, marks him as one who was no mere copyist of Italian fashions, and his crowning achievement, St. Paul's Cathedral, compares favourably with the greatest Renaissance churches on the Continent. His attitude towards his

design for St. James's, Piccadilly, shows him as an architect who was definitely thinking of the efficiency of his buildings. His ability was outstanding, whether in the design of individual buildings or of groups of buildings, while his scheme for the rebuilding of London after the Great Fire shows that he was a brilliant town-planner.

Working during the later part of Wren's life, Vanbrugh (1666–1726), a man with remarkable powers of imaginative design, was responsible for a number of important buildings, including Blenheim Palace and Castle Howard. Of later architects the following may be mentioned :—

Colin Campbell (d. 1734) : Houghton Hall, Norfolk.

Nicholas Hawksmoor (1661–1736) : St. Mary Woolnoth, St. George, Bloomsbury, and Christ Church, Spitalfields, all in London ; also the Old Clarendon Building, Oxford.

Thomas Archer (d. 1734) : St. Philip, Birmingham ; St. John, Smith Square, London.

John James (d. 1746) : St. George, Hanover Square, London.

Giacomo Leoni (1686–1746) : Moor Park, Rickmansworth.

William Kent (1684–1748) : Villa at Chiswick (copy of Palladio's Villa at Vicenza) ; the Horse Guards, London, one of the most picturesque examples of eighteenth-century architecture in England.

James Gibbs (1682–1754) : St. Mary-le-Strand, and St. Martin-in-the-Fields, both in London ; and the Radcliffe Library, Oxford.

John Wood the Elder of Bath (1704–54) : Queen Square, The Circus, Ralph Allen's Town House, etc., Bath.

John Wood the Younger of Bath (1727–82) : The Royal Crescent, Bath.

Sir William Chambers (1726–96) : Somerset House, London—one of the greatest buildings of the English Renaissance.

Robert Adam (1728–92) : The Adelphi Buildings, Boodle's Club, etc., London. He helped to found the classic revival in this country. His great contribution was his ability to design all parts of a scheme in complete harmony, from a group plan to a salt-cellar.

The Classic Revival during the Nineteenth Century

In the first half of the nineteenth century there were two revivals, one classic and the other Gothic : the following are some of the leaders of the classic revival :—

John Nash (1752–1835) : Marble Arch and Old Regent Street, London.

Sir John Soane (1753–1837) : The Bank of England, London. Soane was the modernist of a hundred years ago.

William Wilkins (1778–1839) : The National Gallery, and University College, London.

H. W. Inwood (1794–1843) : St. Pancras Church, London.

ST. PAUL'S CATHEDRAL, LONDON

The crowning achievement of Sir Christopher Wren, comparing favourably with the greatest Renaissance churches on the Continent.

H. L. Elmes (1814–47): St. George's Hall, Liverpool.
Sir Robert Smirke (1780–1867): The British Museum, London.
Professor C. R. Cockerell (1788–1863): Taylor and Randolph Institute, Oxford.

The Gothic Revival

Of the leaders of the Gothic revival may be mentioned :—

Augustus Pugin (1812–52) : St. George's Cathedral, Southwark.

Sir Charles Barry (1795–1860) : The Houses of Parliament, London.

Sir George Gilbert Scott (1811–78) : The Albert Memorial, London.

William Butterfield (1814–1900) : Balliol College Chapel, Oxford.

G. E. Street (1824–81) : The Law Courts, London.

W. Burges (1828–81) : Cardiff Castle.

J. L. Pearson (1817–97) : Truro Cathedral.

A. Waterhouse (1830–1905) : The Natural History Museum, South Kensington.

G. F. Bodley (1827–1907) : St. John the Evangelist, Cowley, Oxford.

The Gothic revival outlived the classic one, and in fact for much—though not all—church work, is still with us ; in this connection it may be mentioned that the architect of Liverpool Cathedral, now in course of construction, is Sir Giles Gilbert Scott, grandson of Sir George Gilbert Scott previously mentioned.

Return to the Classic and the New Art Movement

A return to the English Renaissance was the path taken by such men as George Devey and Norman Shaw in the last quarter of the nineteenth century, while the closing years of that period saw the rise and fall in England of the New Art Movement, of which Macintosh of Glasgow was one of the outstanding figures. The early part of the present century witnessed another classic revival, while since the War English architecture has been in part traditional and in part strongly influenced by Continental movements, which were in some measure stimulated by our own New Art effort of the " 'nineties."

Town Planning during the Renaissance

During the Renaissance period there were great developments of town planning. In Italy may be mentioned the fine scheme for the approach to the cathedral of S. Peter, Rome, and special reference should be made to the outstanding developments in garden planning in that country. In France there were many notable town-planning schemes, including the remarkable example at Nancy, and the lay-out of the Place de la Concorde, Paris ; while in Great Britain the development of Edinburgh and the work carried out by the Woods in the City of Bath are particularly noteworthy.

REFERENCE BOOKS

Sir Banister Fletcher : *The History of Architecture on the Comparative Method.*
F. M. Simpson : *The History of Architectural Development,* Vol. III.
Sir T. G. Jackson : *The Renaissance of Roman Architecture.*
Anderson and Stratton : *The Architecture of the Renaissance in Italy.*
J. C. Raschdorff : *Palast-Architektur.*

Sir Reginald Blomfield : *History of French Architecture*, 1494–1774.
Three Hundred Years of French Architecture.
W. H. Ward : *French Renaissance Architecture*, 1495–1830.
C. Sauvageot : *Palais, Châteaux, Hôtels et Maisons de France.*
C. Daly : *Motifs historiques d'architecture et de sculpture.*
Sir Reginald Blomfield : *History of Renaissance Architecture in England.*
Gotch and Brown : *Architecture of the Early Renaissance in England.*
J. A. Gotch : *Early Renaissance Architecture.*
The Growth of the English House.
Garner and Stratton : *Domestic Architecture in England during the Tudor Period.*
Belcher and Macartney : *Later Renaissance Architecture in England.*
A. E. Richardson : *Monumental Classic Architecture in Great Britain and Ireland.*
M. and C. H. B. Quennell : *History of Everyday Things in England*, 1500–1934.
The Good New Days.
Geoffrey Scott : *The Architecture of Humanism.*

THE INFLUENCE OF MATERIALS ON ARCHITECTURAL DESIGN

In Greek Architecture

THE Parthenon, at Athens, and many other Greek temples were constructed of a very beautiful marble—a material which played an important part in the development of Greek architecture. In certain of the buildings dark marbles were used for some of the features, as, for instance, in the Erechtheum, where white marble sculptures were secured to a dark marble frieze. At Sunium a veined marble is used, conflicting with the flutes in a somewhat unfortunate way, but broadly speaking the delicate mouldings and enrichments of Greek architecture were developed in an unveined, pale marble.

Where such material was not available, and a rougher stone had to be used, this was often coated with a fine stucco in which the delicate effects required could be secured to better advantage.

In Roman Architecture

In Roman architecture, columns were frequently left unfluted, probably because of the fact that they were frequently made of materials difficult to flute or in which the veins would conflict with flutes, and the architects of the Byzantine period followed a similar practice.

The Use of Concrete in Roman Architecture

It was, however, the use of concrete which played the most important part in Roman architecture, for this enabled them to construct vast vaulted structures with a minimum number of skilled workmen, the concrete being covered by superior materials, such as stone externally, and with marble, etc., internally, a method developed further in Early

Christian and Byzantine architecture, in which mosaics played an important part. The Romans also made considerable use of brick as a constructional material, and in their work this was covered with facing materials.

In the Byzantine period brick was developed in an interesting manner as an external treatment.

Masonry

In their masonry work the Romans used stones of considerable size. A special case may be mentioned of the three great stones in the substructure of the Temple of the Sun at Baalbec. These stones were brought from a quarry in the neighbourhood where there is a worked stone 77 ft. by 15 ft. by 14 ft., weighing approximately 820 tons. Apart from such special cases, however, the size of stone used plays a considerable part in the giving of scale to a building, and for that reason great care must be taken in deciding on the size of the stones to be used for a particular purpose.

The Romanesque Architecture

The Romanesque builders were unable to use such large blocks as those normally employed by the Romans, and were therefore unable to make the arch in a thick wall with a flat soffit. The recessed arches which resulted played a particularly important part in the development of Romanesque work. In the Gothic architecture which followed, this treatment was further developed in a remarkable manner, as may be seen in such west fronts as those of Bourges, Rheims, Amiens, etc.

Early Gothic—Marble and Brick

In Early Gothic in England, considerable use was made of Purbeck marble in slender shafts. The reintroduction of brick in English Gothic architecture is noteworthy, as is also the great development of stained glass, side by side with the development of the window.

Renaissance—Plaster

During the Renaissance great use was made of plaster, both internally, for ceilings, etc., and externally, in the form of stucco, this latter having considerable effect on the design of the work of such men as the Brothers Adam, and Nash, in the Later Renaissance in England.

The Use of Coverings

In more recent times the great use of steel and form concrete has given rise to the use of various materials as "coverings," as in the days of ancient Rome, and even in the great period of Greek architecture. Such covering materials have been condemned by certain writers, but

considerable thought has been given to methods of using them so that they appear obviously as coverings.

Local Materials

Another point to which considerable attention is being paid at the present time is that of using materials suitable to a particular locality. In earlier times local material was normally used, but with the great development of transport in recent times there is a tendency for that custom to break down on the score of economy. Care, however, must be taken to avoid the use of incongruous materials, such as, for instance, red brick in the Cotswolds.

Where Two or More Materials Are Used

Where two or more materials are used in combination in an exterior, broadly speaking the stronger material should be used in the lower part, and great care should be taken in dealing with materials of strongly contrasting colours in order to avoid the tendency to "split up" the design. For the same reason it is unwise to use red ridge and hip tiles with slate roofs.

Care, also, should be taken to treat each material in the manner to which it is best suited: the type of carving suitable for wood is, for instance, normally unsuitable for stone, and forms suitable for wrought iron are not suitable for cast iron.

BUILDERS' ESTIMATING

PART III.—CARPENTERY AND JOINERY

TIMBER FOR CARPENTER

THE fir timber used for carpenters' work will, in the majority of cases, be purchased in the scantling size required for use. When the size of timber required is greater than imported scantling sizes, balk fir will be used and converted to the requisite dimensions.

Timber should be purchased to a suitable specification for lengths, in which case a provision of 5 per cent. should be sufficient for length, cutting waste. If the timber is purchased in random lengths the waste will be considerably in excess of this amount.

The normal method of selling softwoods is by the Petrograd standard (abbreviated P.S.H.), containing 165 cu. ft. of timber.

The price of timber varies not only with the quality of the timber, but also according to its scantling size.

Method of "Billing" Timber

The general method of "billing" timber in carpenters' work is in cubic feet, each scantling size being separately given, to enable the work to be priced according to the purchase price of the various sizes. When no scantling sizes are given, or where various scantling sizes are grouped together, an average price of timber must be taken.

Ridges, hips, and valleys are measured by the foot run.

LABOUR VALUES

Per Foot Cube	*Carpenter*	*Labourer*
	hour	*hour*
Fir in lintels	$\frac{2}{5}$	—
,, ,, plates, halved	$\frac{2}{5}$	—
,, ,, ground joists	$\frac{2}{5}$	$\frac{1}{5}$
,, ,, ceiling joists	$\frac{1}{2}$	$\frac{1}{4}$
,, framed in floors	$\frac{3}{5}$	$\frac{1}{4}$
,, ,, ,, roofs	$\frac{3}{4}$	$\frac{3}{8}$
,, ,, ,, partitions	1	$\frac{1}{2}$
,, ,, ,, trussed partitions	$1\frac{1}{4}$	$\frac{1}{2}$
,, ,, roof trusses, exclusive of hoisting	$1\frac{1}{4}$	$\frac{1}{2}$

Examples of Detailed Price Analysis

For the purpose of the examples the timber is taken at an average price of £20 per P.S.H. to selected lengths, delivered site.

		s.	d.
(39) *Fir in lintels.*			
1 ft. cube fir	@ 2s. 5d.	2	5
Waste, 5 per cent.	.. ..		1½
Carpenter ⅖ hour	@ 1s. 8d.		8
	Per foot cube, net	3	2½
(40) *Fir framed in roofs.*			
1 ft. cube fir	@ 2s. 5d.	2	5
Waste, 5 per cent.	.. ..		1½
Nails, say	.. ..		½
Carpenter, ¾ hour	@ 1s. 8d.	1	3
Labourer, ⅜ ,,	@ 1s. 3d.		5½
	Per foot cube, net	4	3½
(41) *Fir framed in trussed partitions.*			
1 ft. cube fir	@ 2s. 5d.	2	5
Waste, 5 per cent.	.. ..		1½
Carpenter, 1¼ hour	@ 1s. 8d.	2	1
Labourer, ½ ,,	@ 1s. 3d.		7½
	Per foot cube, net	5	3

Roof Trusses

Fir framed in roof trusses will be priced in a manner similar to that given for trussed partitions, but in the majority of cases the timber will be converted from balk fir at a relatively higher price than for timber in imported scantling sizes.

It will be more convenient to purchase large timbers for carpenters' work sawn to the actual sizes required from balk timber. If the timber is purchased in balk sizes, 25 per cent. should be added for waste in conversion, and an allowance of from 3*d.* per foot cube provided for sawing to the size required.

The following prices are for hoisting timber roof trusses by hand, assuming that a minimum of three trusses is to be fixed in one building.

	Hoisting up to 40 ft. in height		*Each additional 10 ft. in height above 40 ft.*	
	s.	d.	s.	d.
King-post roof truss, 30-ft. span	10	0	2	6
Queen-post roof ,, 40-ft. ,,	13	6	3	6
,, ,, ,, ,, 50-ft. ,,	16	9	4	3
,, ,, ,, ,, 60-ft. ,,	20	0	5	0

Labour values for fixing ironwork to trusses, etc.	*Carpenter*
Wrought-iron straps	8 hrs. per cwt.
Cast-iron heads and shoes	2½ ,, ,, ,,
Extra for fixing gibs and cottars	½ hr. ,, set

The value of boring fir and fixing bolts and nuts not exceeding ¾-in. diameter is approximately 1*d.* for each inch in length of bolt.

CUBE TIMBER FIXED COMPLETE

NET COST—PER FOOT CUBE

Description	*Purchase Price of Timber in Selected Lengths, Delivered Site, per P.S.H.*											*Adjustment for 1d. per hour on Wages*
	£14	£15	£16	£17	£18	£19	£20	£21	£22	£23	£24	
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*d.*
Lintels	2 4¼	2 5¾	2 7¼	2 8¾	2 10¼	2 11¾	3 1¼	3 2¾	3 4¼	3 5¾	3 7½	⅓
Plates	2 5½	2 7	2 8½	2 10	2 11½	3 1	3 2½	3 4	3 5½	3 7	3 8¾	⅖
Ground joists	2 9	2 10½	3 0	3 1½	3 3	3 4½	3 6	3 7½	3 9	3 10½	4 0¼	⅗
Ceiling joists	2 11½	3 1¼	3 2¾	3 4¼	3 5¾	3 7¼	3 8¾	3 10¼	3 11¾	4 1¼	4 3	¾
Framed in :—												
floors	3 1¾	3 3¼	3 4¾	3 6¼	3 7¾	3 9¼	3 10¾	4 0¼	4 1¾	4 3¼	4 5	⅞
roofs	3 5½	3 7	3 8½	3 10	3 11½	4 1	4 2½	4 4	4 5½	4 7	4 8¾	1⅛
partitions	4 1½	4 3	4 4½	4 6	4 7½	4 9	4 10½	5 0	5 1½	5 3	5 4¾	1½
trussed partitions ..	4 6	4 7½	4 9	4 10½	5 0	5 1½	5 3	5 4½	5 6	5 7½	5 9¼	1¾
roof trusses, exclusive of hoisting	4 6	4 7½	4 9	4 10½	5 0	5 1½	5 3	5 4½	5 6	5 7½	5 9¼	1¾

Tabulated Values for Cube Timber in Carpenters' Work

The Table gives the price of timber fixed complete, at various purchase prices per P.S.H., with adjustment figures for each 1*d.* per hour variation on the rates of both carpenter and labourer.

A Table is also given showing the relative prices per foot cube and per foot run for various scantling sizes, for pricing ridges, hips, valleys, and other timbers billed by the foot run.

The basic labour rates on which the Table is calculated are: carpenter, 1*s.* 8*d.* per hour; labourer, 1*s.* 3*d.* per hour.

SCANTLING TIMBERS FIXED COMPLETE

NET COST—PER FOOT RUN

Sectional Area of Timber in Square Inches	*Basis Price per Foot Cube Fixed Complete*								
	2*s*. 0*d*.	2*s*. 6*d*.	3*s*. 0*d*.	3*s*. 6*d*.	4*s*. 0*d*.	4*s*. 6*d*.	5*s*. 0*d*.	5*s*. 6*d*.	6*s*. 0*d*.
	s. *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*
72	1 0	1 3	1 6	1 9	2 0	2 3	2 6	2 9	3 0
69	11½	1 2⅜	1 5¼	1 8⅛	1 11	2 1⅞	2 4¾	2 7⅝	2 10½
66	11	1 1¾	1 4½	1 7¼	1 10	2 0¾	2 3½	2 6¼	2 9
63	10½	1 1⅛	1 3¾	1 6⅜	1 9	1 11⅝	2 2¼	2 4⅞	2 7½
60	10	1 0½	1 3	1 5½	1 8	1 10½	2 1	2 3½	2 6
57	9½	11⅞	1 2¼	1 4⅝	1 7	1 9⅜	1 11¾	2 2⅛	2 4½
54	9	11¼	1 1½	1 3¾	1 6	1 8¼	1 10½	2 0¾	2 3
51	8½	10⅝	1 0¾	1 2⅞	1 5	1 7⅛	1 9¼	1 11⅜	2 1½
48	8	10	1 0	1 2	1 4	1 6	1 8	1 10	2 0
45	7½	9⅜	11¼	1 1⅛	1 3	1 4⅞	1 6¾	1 8⅝	1 10½
42	7	8¾	10½	1 0¼	1 2	1 3¾	1 5½	1 7¼	1 9
39	6½	8⅛	9¾	11⅜	1 1	1 2⅝	1 4¼	1 5⅞	1 7½
36	6	7½	9	10½	1 0	1 1½	1 3	1 4½	1 6
33	5½	6⅞	8¼	9⅝	11	1 0⅜	1 1¾	1 3⅛	1 4½
30	5	6¼	7½	8¾	10	11¼	1 0½	1 1¾	1 3
27	4½	5⅝	6¾	7⅞	9	10⅛	11¼	1 0⅜	1 1½
24	4	5	6	7	8	9	10	11	1 0
21	3½	4⅜	5¼	6⅛	7	7⅞	8¾	9⅝	10½
18	3	3¾	4½	5¼	6	6¾	7½	8¼	9
15	2½	3⅛	3¾	4⅜	5	5⅝	6¼	6⅞	7½
12	2	2½	3	3½	4	4½	5	5½	6
9	1½	1⅞	2¼	2⅝	3	3⅜	3¾	4⅛	4½
6	1	1¼	1½	1¾	2	2¼	2½	2¾	3

Boarding to Roofs

Boarding, other than planed boarding, is sold by the Petrograd standard, which contains the following quantities of sawn boards :—

Boards 1¼ in. thick	.. .. ..	16 squares per standard
,, 1 in. ,,	.. .. ..	20 ,, ,, ,,
,, ¾ in. ,,	.. .. ..	26 ,, ,, ,,

Waste on sawn boarding for roof work, 7½ per cent.

LABOUR VALUES PER SQUARE

	Carpenter	*Labourer*
Laying boarding to pitched roofs		
¾-in. rough boarding	2½ hours	1¼ hour
1-in. ,, ,, ...	2¾ ,,	1⅜ ,,
1¼-in. ,, ,, ...	3 ,,	1½ ,,
Laying boarding to flat roofs		
¾-in. rough boarding	2½ hours	1 hour
1-in. ,, ,, ...	2¾ ,,	1 ,,
1¼-in. ,, ,, ...	3 ,,	1 ,,
Extra labour traversing rough boarding for lead	1 ,,	—
,, ,, firring boarding to falls (average depth of firrings, 2 in.)	2½ ,,	1¼ ,,

Battening for Slating and Tiling

MATERIALS AND LABOUR—PER SQUARE

Battening for Slating, 3-in. Lap. Length of Slate	*Battens*	*Labour*		*Wire Nails*
		Carpenter	*Labourer*	
18 in.	176 ft.	$1\frac{2}{3}$ hour	$\frac{5}{6}$ hour	1 lb.
20 in.	155 ft.	$1\frac{1}{2}$,,	$\frac{3}{4}$,,	1 lb.
22 in.	140 ft.	$1\frac{1}{3}$,,	$\frac{2}{3}$,,	$\frac{3}{4}$ lb.
24 in.	126 ft.	$1\frac{1}{5}$,,	$\frac{3}{5}$,,	$\frac{3}{4}$ lb.
Slating laid in diminishing courses, average	150 ft.	$1\frac{1}{2}$,,	$\frac{3}{4}$,,	1 lb.
Battening for Tiling. Gauge of Tile				
4 in.	330 ft.	$2\frac{1}{2}$ hours	$1\frac{1}{4}$ hour	$1\frac{1}{5}$ lb.
$3\frac{1}{2}$ in.	377 ft.	3 ,,	$1\frac{1}{2}$,,	$1\frac{1}{3}$ lb.
3 in.	440 ft.	$3\frac{1}{2}$,,	$1\frac{3}{4}$,,	$1\frac{1}{2}$ lb.
Counter-battening				
12-in. centres	110 ft.	1 hour	$\frac{1}{2}$ hour	$\frac{3}{4}$ lb.

Examples of Detailed Price Analysis

(42) 1-*in. rough boarding laid to pitched roof.*

	£	s.	d.
1 square 1-in. rough boarding at £18 per P.S.H.—$\frac{£18}{20}$		18	0
Waste, $7\frac{1}{2}$ per cent.		1	4
Carpenter, $2\frac{3}{4}$ hours . . . . @ 1*s.* 8*d.*		4	7
Labourer, $1\frac{3}{8}$ hours . . . . @ 1*s.* 3*d.*		1	$8\frac{1}{2}$
$2\frac{1}{2}$ lb. nails . . . . @ 2*d.*			5
Per square, net	£1	6	$0\frac{1}{2}$

(43) 1-*in. rough boarding firred to falls* (*average depth* 2 *in.*).

	£	s.	d.
1 square 1-in. rough boarding . . . . @ £18 P.S.H.		18	0
Waste, $7\frac{1}{2}$ per cent.		1	4
90-ft. run of fir 2 in. wide, average depth 2 in.—$2\frac{1}{2}$ ft. cube @ 2*s.* 5*d.*		6	$0\frac{1}{2}$
4 lb. nails . . . . @ 2*d.*			8
Sawing firring timber—45 ft. 2-in. flatting (to produce 90-ft. run of firrings) . . . . @ 2*s.* 0*d.* per 100 ft.			
Carpenter, $5\frac{1}{4}$ hours . . . . @ 1*s.* 8*d.*		8	9
Labourer, $2\frac{1}{4}$,, ... @ 1*s.* 3*d.*		2	10
Per square, net	£1	17	$7\frac{1}{2}$

(44) 1-*in. by* 2-*in. fir battening for* 20-*in. by* 12-*in. slating, laid to* 3-*in. lap.*

	£	s.	d.
155 ft. 1-in. by 2-in. fir battens . . . . @ 2*s.* 0*d.* per 100 ft.		3	$1\frac{1}{2}$
1 lb. wire nails			$2\frac{1}{2}$
Carpenter, $1\frac{1}{2}$ hour . . . . @ 1*s.* 8*d.*		2	6
Labourer, $\frac{3}{4}$,, ... @ 1*s.* 3*d.*			11
Per square, net		6	9

(45) *1-in. by 1¼-in. fir battening for tiling laid to 4-in. gauge.*		s.	d.
330 ft. 1-in. by 1¼-in. fir battens	@ 1s. 4d. per 100 ft.	4	5½
1⅕ lb. fine wire nails			4
Carpenter, 2½ hours	@ 1s. 8d.	4	2
Labourer, 1¼ ,,	@ 1s. 3d.	1	7
	Per square, net	10	6½

FLOORINGS AND MATCHINGS

Materials—Boards

Square-edge and tongued and grooved boards are sold by the square, nominal widths.

On prepared square-edge boards there is a loss of ¼ in. in the width of each board due to edge preparation. With tongued and grooved boarding there is a further loss of ¼ in. in width of board as laid, for the loss of space due to the tongued and grooved edge.

Waste will vary with the width of board. The following waste values include both edge waste and waste due to length cutting.

	Square-edge Boards	*Tongued and Grooved Boards*
6-in. widths	10 per cent.	15 per cent.
4½-in. ,,	12½ ,, ,,	20 ,, ,,

Nails

The length of the nails used for fixing boarding is normally 1½ in. longer than the thickness of the board.

Quantity of nails required per square :—

¾-in. boards	3 lb.	1¼-in. boards	5½ lb.
1-in. ,,	4 lb.	1½-in. ,,	7 lb.

Labour Fixing Floorings and Matchings

The following labour values are for laying and cleaning off deal floorings, and fixing matchings, in 6-in. widths.

Thickness of Board	*Square-edge Flooring*		*Tongued and Grooved Flooring*		*Matching*	
	Carpenter	*Labourer*	*Carpenter*	*Labourer*	*Carpenter*	*Labourer*
¾ in.	4½ hours	1 hour	5¼ hours	1 hour	5½ hours	1 hour
1 in.	4¾ ,,	1 ,,	5½ ,,	1 ,,	6 ,,	1 ,,
1¼ in.	5¼ ,,	1 ,,	6 ,,	1 ,,	—	—
1½ in.	5¾ ,,	1½ ,,	6½ ,,	1½ ,,	—	—

Examples of Detailed Price Analysis

(46) *1¼-in. by 6-in. square-edge flooring, laid and cleaned off.*

		£	s.	d.
1 square 1¼-in. by 6-in. seconds-quality square-edge flooring	@ 24s. 6d.	1	4	6
Waste, 10 per cent.	.. ..		2	5½
5½ lb. 2¾-in. floor brads	@ 2d.			11
Carpenter, 5¼ hours	@ 1s. 8d.		8	9
Labourer, 1 hour	@ 1s. 3d.		1	3
	Per square, net	£1	17	10½

(47) *1¼-in. by 6-in. tongued and grooved flooring, laid and cleaned off.*

		£	s.	d.
1 square 1¼-in. by 6-in. seconds-quality tongued and grooved flooring	@ 25s. 0d.	1	5	0
Waste, 15 per cent.	.. ..		3	9
5½ lb. 2¾-in. floor brads	@ 2d.			11
Carpenter, 6 hours	@ 1s. 8d.		10	0
Labourer, 1 hour	@ 1s. 3d.		1	3
	Per square, net	£2	0	11

(48) *¾-in. by 4½-in. V-jointed matching, fixed to walls.*

			£	s.	d.
1 square ¾-in. by 4½-in. seconds-quality V-jointed matching		@ 17s. 0d.		17	0
Waste, 20 per cent.		.. ..		3	5
3 lb. cut nails		@ 2d.			6
Carpenter. Basis labour for 6-in. widths	5½ hours				
Extra for 4½-in. widths	1 hour				
Total	6½ hours	@ 1s. 8d.		10	10
Labourer, 1 hour		@ 1s. 3d.		1	3
		Per square, net	£1	13	0

Cutting and Waste

All straight cutting is included in the price per square as laid. Raking cutting and waste may conveniently be priced as being equal in value to ¾ ft. super of boarding laid complete, for each foot run. Circular cutting and waste, 33 per cent. more than raking cutting.

TIMBER FOR JOINER

Deal Joinery

Pricing joiners' work involves a detailed analysis of the materials for each individual item of joinery. Owing to limitations of space in this article it is possible to deal only with a few typical examples, illustrating the method of building up a complete unit price.

The method adopted for pricing the joiners' timber is based upon buying the timber freshly imported, and to stack and dry it in the builder's yard. To the initial dock price of the timber in deal sizes is added a charge of £11 per standard, to cover all contingent costs to produce timber of the sizes required for the article of joinery as shown on the setting-out rod. This figure of £11 per standard includes the cost of haulage, stacking, and stripping, interest on capital outlay for one year,

allowance for sawing the timber to boards and small scantling sizes, and waste in conversion and cutting to lengths.

Prices are based upon timber equal in value to seconds yellow deal. The final price of the timber is based upon a cost of £34 10*s.* per P.S.H. in docks, plus £11 per P.S.H. for the incidental charges and waste in conversion, a total price of £45 10*s.* per standard for the timber converted to rod sizes. This figure is equal to approximately 5½*d.* per foot super 1 in. thick, the unit adopted for general use in pricing the detailed analyses.

The preparation of joinery is chiefly carried out by a series of machine operations, and the cost of these individual operations will vary considerably with the total quantity of each similar item to be produced. The costs of preparation are given in money values, and are for work carried out to detail, without large repetition. When the work is in large quantities, or, for example, stock-pattern doors or mouldings may be used, a considerable saving in cost will be effected.

Where possible, fixing labours are separately given.

Unless mentioned to the contrary, the thickness given for prepared joinery is nominal, $\frac{1}{16}$ in. being allowed for each wrought face. When joinery is required to hold up the full thickness specified, the price must be increased to provide for the additional thickness of timber.

DOORS

Panelled Doors

In order to save the labour of fully analysing the cost of materials for panelled doors of various types, the deal four-panel square door may be taken as a basis upon which to price other types of panelled doors. Full details of the materials cost of a four-panel square door are given, with a series of extra values for panelled doors of other types.

Example of Detailed Price Analysis

(49) *Deal four-panel square door, size* 2 *ft.* 10 *in. by* 6 *ft.* 10 *in. by* 2 *in. thick.*

Total quantity of materials.

2/2·10
·9
—— 4·3 2-in. deal (bottom and middle rails)
22·6
·4½
—— 8·5 ditto (stiles and rails)
12·8 super.

Top rail	2	10
Stiles	13	8
Muntins	5	6
Horns		6
	22	6

2/3·3
·11
—— 6·0 ¾-in. deal (top panels)
2/1·11
·11
—— 3·6 ditto (bottom panels)
9·6 super.

Total cost of materials (A)		s.	d.
12⅔ ft. super deal 2 in. thick	@ 11*d.*	11	7
9½ ft. " " ¾ in. "	@ 4*d.*	3	2
Wedges, glue, etc.			3
Total cost of materials for door		15	0

Area of door = 2 ft. 10 in. by 6 ft. 10 in. = 19⅓ ft. super.

Cost of materials per foot super = $\frac{15s.\ 0d.}{19\frac{1}{3}}$ = 9⅜*d.*, = say, 9½*d.* per foot super.

Preparation Values

The following values are for machine preparation, the framing and cleaning off being carried out by hand labour. Hanging labours include for fitting and hanging the door, including fixing ordinary types of butt hinges.

DEAL FOUR-PANEL SQUARE DOORS (PER FOOT SUPER)

Preparation only	d.
Doors 1½ in. thick	8
Doors 1¾ in. and 2 in. thick	10
Hanging	
Doors 1½ in. thick	Carpenter, $\frac{1}{12}$ hour
Doors 1¾ in. and 2 in. thick	" $\frac{1}{10}$ "

Extra values on deal four-panel square doors (per foot super)	d.
Panel moulding (each side)	1¾
Bolection moulding (each side)	3½
Mouldings worked on solid, including extra width of framing	2¾
Bead, butt and square doors, 1¾ in. thick	2¾
" " " " " 2 in. "	3½
" flush and square doors, 1¾ in. thick	3½
" " " " " 2 in. "	4½
" and butt both sides doors, 1¾ in. thick	6
" " " " " " 2 in. "	7½
" " flush both sides doors, 1¾ in. thick	8
" " " " " " 2 in. "	9½
Doors with diminished stiles, the upper portion framed as a sash in six squares :—	
1¾ in. thick	3½
2 in. "	4½
Extra on last two items for deal glazing beads, bradded in, per set	3
Extra for ditto if fixed with brass screws and cups, per set	6
Extra for doors hung folding	1

	Materials Cost	*Preparation Cost*	*Hanging—Carpenter*
	d.	s. d.	hour
Ledged and braced doors, 1¾ in. thick	4	5	$\frac{1}{20}$
Framed, ledged, and braced doors, 1¾ in. thick	6½	1 3	$\frac{1}{12}$
2 in. "	8	1 3	$\frac{1}{10}$
2¼ in. "	9½	1 6	$\frac{1}{10}$
2½ in. "	11½	1 6	$\frac{1}{8}$

Examples of Price Analysis

(50) *Deal four-panel square door, 2 in. thick.*

		s.	d.
Materials as detail (Example No. 49A)			9½
Cost of preparation			10
Hanging. Carpenter, $\frac{1}{10}$ hour	@ 1s. 8d.		2
Per foot super, net		1	9½

(51) *Deal four-panel door, moulded two sides, 2 in. thick.*

		s.	d.
Basis cost of 2-in.-thick deal four-panel square door		1	9½
Extra for panel moulding two sides, 2 @ 1¾d.			3½
Per foot super, net		2	1

(52) *Deal four-panel door, bead and butt one side and panel moulded the other side, 2 in. thick.*

		s.	d.
Basis cost of 2-in.-thick deal four-panel square door		1	9½
Extras	d.		
Bead and butt one side	3½		
Panel moulding one side	1¾		
	—		5¼
Per foot super, net		2	2¾

(53) *Deal three-panel doors, hung folding, the upper panels prepared for glass in six squares, lower panel moulded both sides, 2 in. thick.*

		s.	d.
Basis cost of 2-in.-thick deal four-panel square door		1	9½
Extras	d.		
Top panel prepared for glass in six squares	4½		
Lower panels moulded both sides, say one-half cost of moulding the whole door—½ @ 3½d.	1¾		
Extra for doors hung folding	1		
	—		7¼
Per foot super, net		2	4¾

Rebated and beaded meeting stiles .. .. .. 1½d. per foot run extra
Rounded edge to stiles .. .. 1d. ,, ,, ,, ,,

SASHES

Deal moulded casements (*per foot super*).	*Materials Cost* d.	*Preparation Cost* s. d.
1½ in. thick, in one square	2½	8
1¾ in. ,, ,, ,, ,,	3	8
2 in. ,, ,, ,, ,,	3½	9½
1½ in. ,, ,, six squares	3½	11
1¾ in. ,, ,, ,, ,,	4½	11
2 in. ,, ,, ,, ,,	5½	1 1
Fitting and hanging, all thicknesses	Carpenter, ⅙ hour	
Fitting and fixing, all thicknesses	,, $\frac{1}{10}$,,	

Deal cased frames (*with oak cills*) *and double-hung sashes* (*exclusive of pulleys, weights, and lines*).	s. d.	s. d.
Cased frames and sashes, 1¾ in. thick, in one square	9½	1 3
,, ,, ,, ,, 2 in. ,, ,, ,, ,,	1 0	1 4
,, ,, ,, ,, 1¾ in. ,, ,, six squares	10½	1 5
,, ,, ,, ,, 2 in. ,, ,, ,, ,,	1 1	1 7
Fitting frames and hanging sashes	Carpenter, $\frac{1}{12}$ hour	

Examples of Detailed Price Analysis

(54) *Deal moulded casement in six squares, 2 in. thick.*

	s.	d.
Materials		5½
Cost of preparation	1	1
Fitting and hanging. Carpenter, $\frac{1}{6}$ hour .. .. @ 1*s.* 8*d.*		3½
Per foot super, net	1	10

(55) *Deal cased frame with oak cill, and 2-in.-thick deal moulded sashes, in six squares.*

	s.	d.
Materials	1	1
Cost of preparation	1	7
Fixing frame and hanging sashes. Carpenter $\frac{1}{12}$ hour @ 1*s.* 8*d.*		1¾
Per foot super, net	2	9¾

SOLID FRAMES

Preparation Costs.	*Per Foot Cube*	
Fully preparing, framing, and fixing solid frames :—	s.	d.
Deal frames from 6 in. to 12 in. in sectional area	6	0
,, ,, above 12 in. and not exceeding 24 in. sectional area ..	5	0
,, ,, exceeding 24 in. sectional area	4	6
Oak cills 12 in. to 24 in. in sectional area	7	6

Examples of Detailed Price Analysis

(56) 3-*in. by* 4-*in. deal wrought, moulded, and rebated frame.*

	s.	d.
1 ft. cube seconds-quality yellow deal, including conversion and waste .. .. @ 5*s.* per foot cube	5	0
Preparation and fixing	6	0
Sundries		3
Basis price per foot cube, net	11	3

Per foot run $= \frac{12}{144} = \frac{1}{12}$ @ 11*s.* 3*d.* = 11¼*d. per foot run.*

(57) 3-*in. by* 7-*in. oak wrought, weathered, throated, and grooved cill.*

	s.	d.
1-ft.-cube cill, oak .. .. @ 7*s.* per ft. cube	7	0
Waste, 10 per cent.		8½
Sundries		1½
Preparation and fixing	7	6
Basis price, per foot cube, net	15	4

Per foot run $= \frac{21}{144}$ @ 15*s.* 6*d.* = 2*s.* 3*d. per foot run.*

STAIRS

Stairs in Deal

The following are net cost prices, and include materials, preparation, and fixing.

TREADS AND RISERS

	Per Foot Super	
	s.	d.
1¼-in. wrought deal tread with rounded nosing and small moulding under, 1-in. wrought deal riser, glued, blocked, and bracketed	2	0
Ditto in winders and risers, measured net	2	8

	Each End s.	d.
Veneered quadrant end to riser and rounded corner to tread	5	0
,, fully bullnosed end to riser and rounded end to tread	7	0
Curtail end to tread and riser	22	6
End of tread and riser cut and mitred to cut string, including returned moulding	2	3
End of tread and riser (flyers), housed to wall string		10½
Wide ends of winders and risers, ditto	1	2
Narrow ends of winders and risers, ditto		9

STRINGS

	Per Foot Run	
1½-in. by 11-in. wrought deal string plugged to wall	1	5
1¾-in. by 11-in. ,, ,, ,, ,, ,, ,,	1	7
1½-in. by 11-in. ,, ,, moulded plugged to wall	1	6½
1¾-in. by 11-in. ,, ,, ,, ,, ,, ,,	1	8½
1½-in. by 11-in. ,, ,, outer string	1	3
1¾-in. by 11-in. ,, ,, ,, ,,	1	5
Moulded deal capping housed to string, per inch of sectional area		1½
1½-in. by 11-in. wrought deal string cut for tread and riser	1	8
1¾-in. by 11-in. ,, ,, ,, ,, ,, ,, ,, ,,	1	10
Ramped strings—three times the value of straight strings.		
Wreathed strings—four times the value of straight strings.		
Circular strings—from twice the value of straight strings.	Each	
Heading joints of string	1	6
End of string framed to newel	1	3

BALUSTERS

	Each	
1¾-in. by 1¾-in. wrought deal balusters, 3 ft. long		9
1¾-in. by 1¾-in. turned deal balusters, from	1	6
Ends of balusters housed		2½
,, ,, ,, ,, on rake		4

NEWELS

	Per Foot Run	
5-in. by 5-in. wrought deal framed newel	2	0
5-in. by 5-in. ,, ,, turned newel, from	3	6

HANDRAILS

Deal moulded handrail, per inch of sectional area		2
Ramped handrail—three times the value of straight handrail.		
Wreathed handrail—five times the value of straight handrail.		
Circular handrail—from three times the value of straight handrail.		
	Each	
Handrail screws and joints	1	9
End of moulded handrail housed to newel	1	3
,, ,, ,, ,, ,, ,, ,, on rake	1	9

SKIRTINGS, ARCHITRAVES, ETC.

The most convenient method of pricing skirtings, architraves, and similar rails, is to treat the timber as fully prepared and moulded, and add for waste and fixing.

The following labours include an average percentage of mitres, fitted ends, etc., unless otherwise stated.

LABOUR FIXING MOULDINGS AND GROUNDS—PER FOOT RUN

	s.	d.
Mouldings and rails under 6 in. wide		$1\frac{3}{4}$
,, ,, ,, 6 in. and under 9 in. wide		2
,, ,, ,, 9 in. to 11 in. wide		$2\frac{1}{2}$
Built-up skirtings excluding mitres, etc. (per foot super)		5
Grounds (not including plugging)		1
,, plugged to brickwork		$2\frac{1}{2}$
Framed grounds (per foot super) from		2
,, ,, plugged to brickwork (per foot super) from		5
Small wrought fillets, nailed		1
,, ,, ,, screwed		$1\frac{1}{2}$

Examples of Detailed Price Analysis

(58) *$1\frac{1}{4}$-in. by 3-in. deal moulded architrave, including splayed grounds.*

	d.	s.	d.
1 ft. run $1\frac{1}{4}$-in. by 3-in. deal moulded architrave			$2\frac{1}{2}$
1 ft. run $\frac{5}{8}$-in. by 2-in. splayed ground			$\frac{1}{2}$
Waste, 10 per cent., say			$\frac{1}{4}$
Labour.	d.		
Fixing architraves, including mitres	$1\frac{3}{4}$		
Fixing ground	1		
	—		$2\frac{3}{4}$
Per foot run, net			6

(59) *$1\frac{1}{4}$-in. by 15-in. two-piece deal moulded skirting on framed grounds plugged to brickwork.*

	d.	s.	d.
1 ft. run $1\frac{1}{4}$-in. by 15-in. specially prepared moulded two-piece skirting			11
Say, $2\frac{1}{2}$ ft. run $\frac{5}{8}$-in. by 2-in. grounds			$1\frac{1}{4}$
Waste, 10 per cent.			$1\frac{1}{4}$
Labour.	d.		
Fixing two-piece skirting	5		
Fixing and plugging grounds, $1\frac{1}{4}$ ft. super, per foot run @ 5*d.*	$6\frac{1}{4}$		
	—		$11\frac{1}{4}$
Per foot run, net		2	$0\frac{3}{4}$

Mitred angles	each 1*s.* 3*d.*
Housed ends	each 1*s.* 0*d.*
Fitted ends	each 6*d.*

JOINERY IN HARDWOODS

It is beyond the scope of this article to deal fully with pricing joinery in hardwoods. The labour cost in preparing and fixing hardwood joinery will be considerably in excess of that given for deal, and varies considerably, even with hardwoods of the same variety. The relative costs of hardwoods vary with the length, width, and thickness of board, plank, or scantling, and also with the amount of figure in various hardwoods. Waste values will vary between square-edged hardwood, and boards or planks with the natural edge ; in the latter case the waste of hardwood in conversion to rod sizes will be at least 50 per cent., and often exceeds this figure.

A convenient method of pricing joinery in hardwoods is to use the price of items of joinery in deal as a basis, and to multiply this basis price by a given factor for the value of similar items of work in the various hardwoods. With reasonable care in application, the method is quite suitable for normal use. Oak, mahogany, and teak are the hardwoods most used for hardwood joinery, and values are given for these woods.

The following multiplying factors for pricing hardwoods from unit prices for deal joinery are based upon good-quality deal joinery prepared from second-quality yellow deal.

HARDWOOD CONVERSION FACTORS FROM DEAL BASIS

	Conversion Factor
Doors and Panelled Framings	
American or Japanese oak	$2\frac{1}{2}$
Honduras mahogany	$2\frac{3}{4}$
Austrian figured oak	3
Burmah teak	$3\frac{1}{4}$
Casements	
American or Japanese oak	2
Honduras mahogany	$2\frac{1}{4}$
Austrian figured oak	$2\frac{1}{2}$
Burmah teak	$2\frac{3}{4}$
Solid Frames	
American or Japanese oak	$2\frac{1}{2}$
Honduras mahogany	$2\frac{3}{4}$
Austrian figured oak	3
Burmah teak	$3\frac{1}{4}$
Stairs.	
(*a*) *Treads, risers, and strings*	
American or Japanese oak	$2\frac{1}{4}$
Austrian figured oak	$2\frac{3}{4}$
Burmah teak	3
(*b*) *Newels, handrails, etc.*	
American or Japanese oak	$2\frac{1}{2}$
Honduras mahogany	$2\frac{3}{4}$
Austrian oak	3
Burmah teak	$3\frac{1}{4}$
(*c*) *Labour units alone*	
Oak and mahogany	2
Teak	$2\frac{1}{4}$

PROPORTION, SCALE, AND RHYTHM

IN ARCHITECTURAL DESIGN

IN discussing the design of buildings, ancient, mediæval, or modern, the terms proportion and scale are frequently used and almost as frequently misunderstood.

Proportion in Architecture

Proportion in architecture is a matter of harmonising the shapes of the different features in a structure with each other and with the whole. In the Parthenon, for instance, the flat form of gable or pediment is in proportion with the rest of the building, fitting in well with its shape and general horizontal treatment, while at the Chamber of Deputies, Paris, the wider pediment requires a still flatter slope, as otherwise the pediment would dwarf the portico beneath. On the other hand, in many early Gothic buildings, the steeply pitched gables are in proportion with the other features, and fit in with the general vertical treatment of the whole structure. It may be noted here that an angle of 45° is rarely satisfactory for a roof line, because of its lack of decision, fitting in with neither a vertical nor a horizontal treatment.

Some writers have given rules for the "proper" proportions for a window. There is no such thing unless all the conditions are stated. In certain circumstances a tall, narrow window will be a good proportion, as, for instance, in certain early Gothic churches; while a long, flat one is a satisfactory arrangement in other cases, as in the well-known Tribunal House at Glastonbury. In the church of St. Nicholas, at Potsdam, the two flanking features are too narrow for the central mass, and are thus an example of bad proportion.

With reference to the proportion of window openings in buildings of classic type, a height of twice the width is often given, and has often been found reasonably satisfactory, but a slightly taller proportion, as used by the French, will generally be found more completely satisfactory in that class of building. Writers have drawn attention to the general disadvantage of all simple proportions as being too obvious and lacking in subtlety, but it should be noted that this does not apply to such forms as cube and double-cube rooms, for the reason that their complete shape is never visible at one time. In many buildings, both old and new, the top-storey windows are often either square or even slightly flatter than a square, such windows acting as a kind of stop to the vertical treatment of the windows below before it reaches the horizontal lines of the cornice or eaves.

The proportion of the side of a square to its diagonal has often been used as a suitable one for the panes of a window of Georgian type, and this proportion, or the double square, has often been found satisfactory for a façade or for the various portions of it, more slender masses rarely being satisfactory. It may be mentioned, as a useful hint in setting up the outlines of building masses in elevation, that the diagonals of similar rectangles will fall either parallel or at right angles to each other, and while fine architecture cannot be achieved by the following of rigid rules, it will be found that similar rectangles compose more easily than dissimilar ones.

Scale in Architecture

Belcher, in his *Essentials of Architecture,* states that scale in architecture may be described as the proper relation in point of size of the several parts of a building to one another and to the whole. A building is said to be designed on a large scale when its parts are few and large in comparison with the whole building, as is the case in the Old Clarendon Building at Oxford. The " Grand Manner " is a term often applied to such a design. In small buildings, such as cottages, the scale should be small, as otherwise the building will look pretentious. On the other hand, a large building will lose in strength if it is designed on a small scale, having its surface, or considerable parts of it, divided up into large numbers of small parts. This matter of scale must be considered in every item ; even the depth of the courses in a stone wall set up a definite scale which should harmonise with that of the main features and that of the whole building.

The same thing applies to the size of the panes of glass in the windows. Many a fine old house has been ruined as a design by substituting sheets of plate glass for the original small panes, with the result that a contradictory scale has been set up. This does not mean that large panes of glass may not be used satisfactorily, but it does mean that they need a special treatment, with the other features in " scale " with them.

Rhythm

Rhythm is a very important matter in architectural design. It is achieved by the repetition of similar figures in a variety of ways, simple and complex. In the regularly spaced piers of such a structure as the Colosseum, in Rome, may be found an example of simple rhythm. A colonnade of coupled columns is an example of compound rhythm, as is also a Romanesque nave with large and small piers alternately, or a triforium with subdivided openings. In the case of the colonnade the " accent " is divided, and in the other cases the " interval " is divided. A more subtle form of rhythm is to be found in many examples of Greek architecture. If, for instance, one considers the front elevation of the Parthenon, a form of graduated rhythm will be noted in the spacing of the columns, which is on a much higher plane than the normal, equally spaced colonnade. Much the same kind of thing may be found in such an example of Greek ornament as the anthemion—a type which will repay the closest study.

THE DESIGN AND PLANNING OF MODERN CHURCHES

WITH planned areas of development springing up all over the country, the provision of churches to serve new districts presents an urgent problem. Church leaders of all denominations are now taking energetic measures to secure favourable sites, and to raise the necessary funds to meet their immediate and future needs. A fresh investigation of the spiritual and practical aspects of church design is, therefore, opportune. Church planning demands a wider outlook if it is to make contact with contemporary life and aspirations. With this in mind an attempt should be made at the outset to envisage the full development of any site selected.

Group Planning

Under ideal conditions this involves the group planning of a church, hall, and school with recreational facilities, and, where necessary, a house for a resident priest or minister. In short, the creation of a religious centre touching human life in all its aspects. Although this complete development of the site should be the ultimate aim, unfortunately experience proves that the mills of time grind slowly in raising the necessary funds, with the result that a complete scheme is seldom realised all at once in this country. Too often the church is built first by one architect, and with the lapse of time the remaining buildings are entrusted to other hands, with disastrous results to the unity of a scheme.

St. Christopher's, Norris Green, Liverpool, may be said to represent a successful example of planning on a triangular site. A church hall and Sunday school are placed to the rear of the church, with a courtyard between them containing an open-air pulpit. This provides ideal conditions for outdoor services in the summer months. The vicarage completes the scheme. The Sunday school is frequently an important element in planning for Nonconformist needs, but unfortunately in many cases the school achieves undue emphasis at the expense of the church.

Orientation

Exigencies of the site often outweigh the importance of eastern orientation, as, for example, the Anglican Cathedral at Liverpool, built upon a rock, with its main axial formation north and south. On the other hand, wherever possible in this connection, the traditional custom of the Church should always be observed. As a rule, however, the following

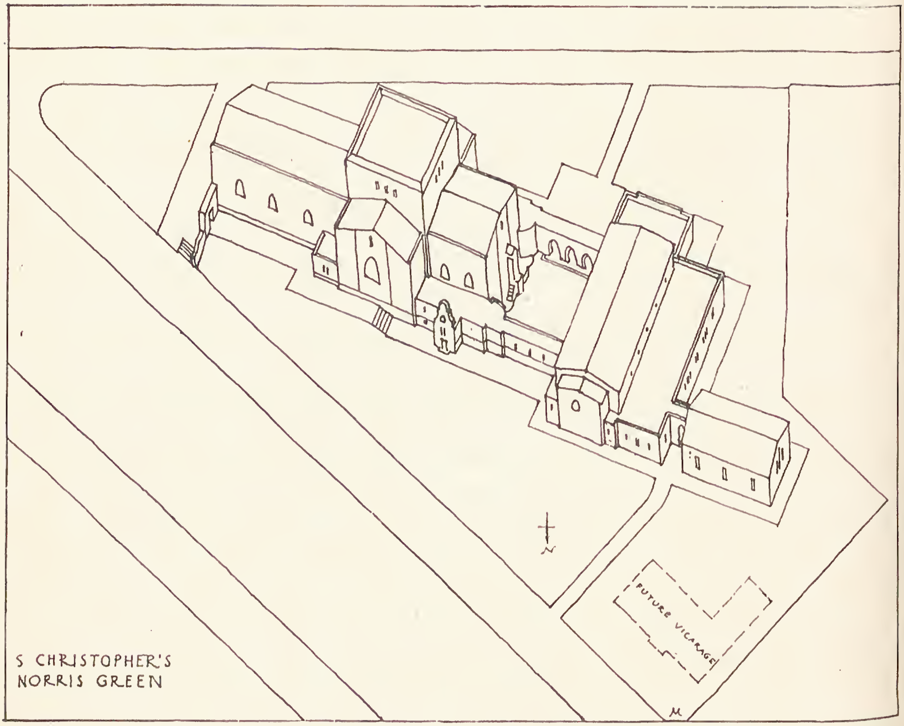


Fig. 1.—ST. CHRISTOPHER'S, NORRIS GREEN, LIVERPOOL

A successful example of planning on a triangular site. Church hall and Sunday school are placed to the rear of the church, with a courtyard between them containing an open-air pulpit. (*Architect: Bernard A. Miller, F.R.I.B.A.*)

considerations take precedence over orientation, namely: the selection of a site adequate to a group plan; the placing of buildings as far away from noisy traffic as possible; and lastly the provision of convenient approaches from the adjoining roads. So much, briefly, for the main issues relative to the site. The character and plan of the church may now be dealt with.

The Church

Character is of the utmost importance to the design of a church. To secure it involves a just balance between inter-related forces. It has to be determined, for instance, how far the design should reflect contemporary influences, on the one hand, and the Church's great traditions on the other. Although discrimination in the choice of new methods of construction and materials should not be overlooked, on the other hand permanence, an enduring quality in ancient church architecture, is still justified to-day. After all, a church should be the outward expression of the eternal, a place set aside for worship, prayer, and meditation of all that lies beyond

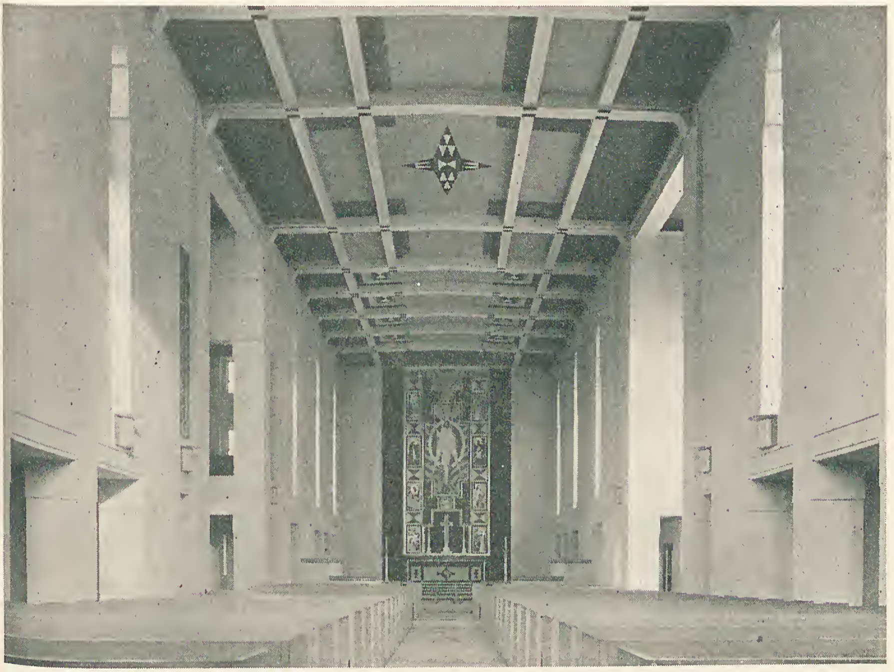


Fig. 2.—ST. CHRISTOPHER'S, WITHINGTON, MANCHESTER

The interior is notable for its proportions and colour, which receive a climax in the lofty painted reredos carried out by Miss Mary Adshead. This is a unique feature of the church. (*Architect : Bernard A. Miller, F.R.I.B.A.*)

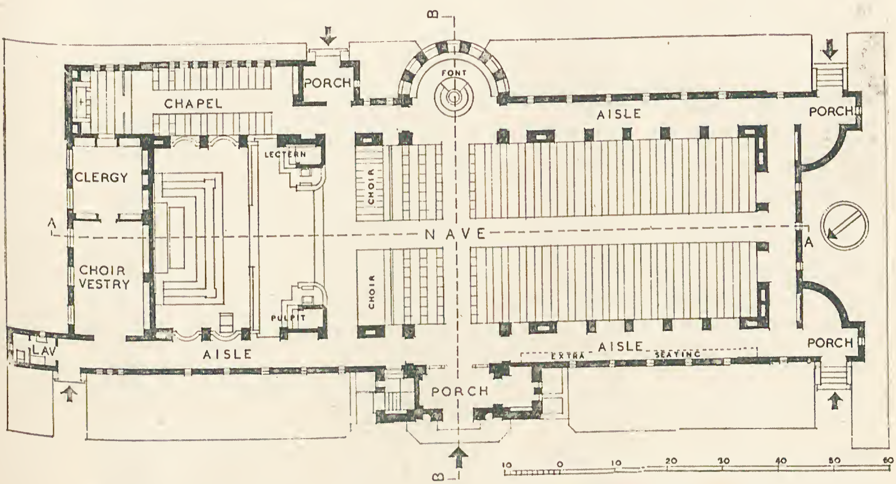


Fig. 3.—ST. CHRISTOPHER'S, WITHINGTON, MANCHESTER—PLAN
(*Architect : Bernard A. Miller, F.R.I.B.A.*)

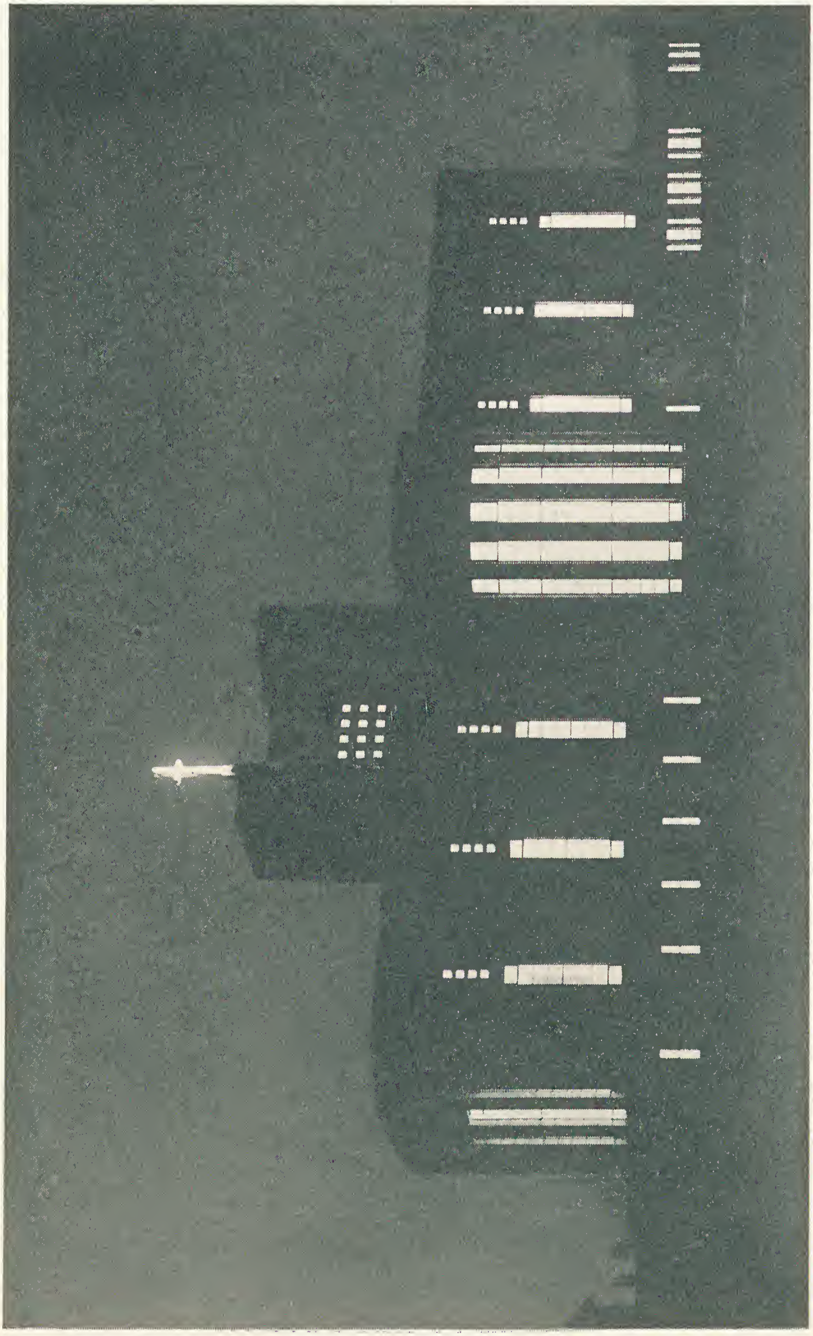


Fig. 4.—ST. CHRISTOPHER'S, WITHINGTON, MANCHESTER

This view shows the church illuminated at night. A tall neon-lighted cross is a feature of the tower, and can be seen for miles round. The character of the design is frankly modern. A semicircular baptistery lit by seven long windows, with a beautiful carved stone font by Alan Durst, is a feature of the building. (*Architect* : *Bernard A. Miller, F.R.I.B.A.*)

the temporal sphere of human thought and action. This may find expression either in a building of dignified proportions conceived primarily as a shell for an altar, or, on the other hand, in the simplicity and restraint of a Quaker meeting-house. The primary function of a church is to provide the right environment for a congregation met together for the purpose of sharing in certain solemn rites and ceremonies. Such a building should, therefore, present favourable conditions for both sight and sound. As many seats as possible should command a clear view of the altar, pulpit, and lectern. The problem of acoustics presents greater difficulties, the nature of which are referred to later.

General Requirements

The essential units in the Church of England plan are : the sanctuary and altar ; the choir, with stalls for the clergy and choristers ; space for the organ conveniently related to the choir ; the nave, with pews or chairs for the use of the congregation, and containing the font, the pulpit, and the lectern ; vestries for the clergy and the choir, with adequate provision for the proper care of altar frontals, linen, and sacred vessels ; one or more chapels for private devotions and daily services ; porches, one of which may well receive special emphasis at the principal entrance ; space for cloaks—a need seldom provided for—together with lavatory and some storage room. Except where electric heating is adopted a heating chamber is in most cases necessary, and should have access under cover, together with adequate light and ventilation.

The Altar

The climax of every church interior should be the altar. The main lines of the architecture and decorations should lead up to this solemn climax, which, in itself, should be so designed as to focus and arrest attention. This is fully explained in the accompanying illustrations of the interiors of St. Saviour's, Eltham, and St. Christopher's, Withington. The traditional practice of placing the altar beneath an east window usually presents difficulties, as the altar and its surroundings tend to become partially obscured by the glare from the window above them. Moreover the window, except where skilfully conceived as a reredos in glass, as at St. Saviour's, Eltham, tends to destroy unity at that point of the design where this quality is most essential. Whatever treatment is finally adopted, whether by painting, carving, or fabrics, it should present a single unified conception. The altar itself should be relatively proportioned to its surroundings. In a sanctuary of ample width and height nothing looks finer than a dignified altar at least 10 ft. to 12 ft. long, 2 ft. 6 in. to 2 ft. 9 in. deep, and 3 ft. 3 in. to 3 ft. 5 in. high. Further, there is very early precedent for this oblong proportion in the early Christian sarcophagus-altars of the Catacombs. An enhanced dignity is secured, wherever space will allow of the altar being brought reasonably

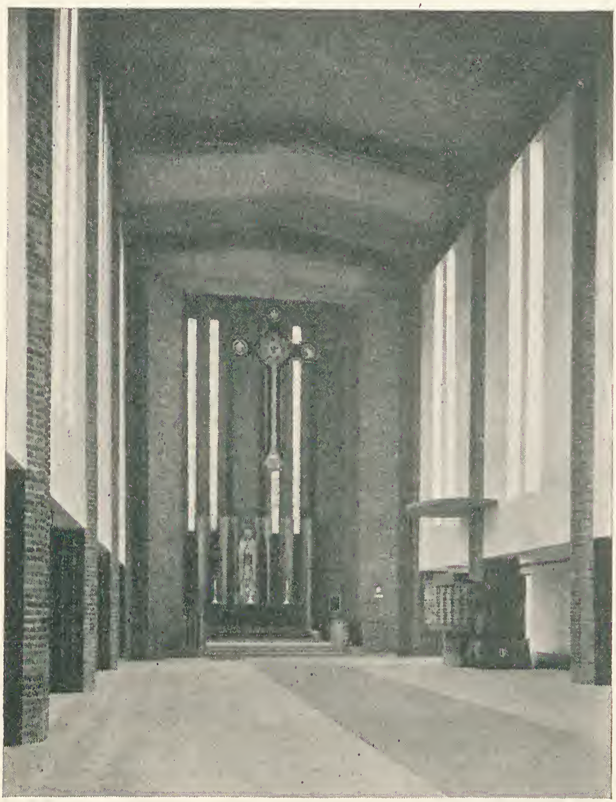


Fig. 5.—ST. SAVIOUR'S, ELTHAM—INTERIOR, LOOKING EAST

Note the skilful use of the window as a reredos in glass. Construction : foundations and roof of reinforced concrete. Walls of purplish-grey brickwork. Nave windows, concrete and glass, with patterned leaded lights to chancel. Internal dimensions 120 ft. long by 40 ft. wide. Sanctuary under low tower, ceiling of which is 50 ft. high. (*Architects: Welch, Cachemaille-Day & Lander, F/A/A.R.I.B.A.*)

well forward in advance of the east wall.

Space permits of no more than a general reference here to the liturgical and historical development of the design of the altar. In early Christian churches the altar stood beneath a ciborium or protective covering supported by pillars. From rods between these four pillars hung the curtain which veiled and enshrined the altar during the most solemn part of the Eucharist. The traditional English altar of a later date retained many of the essentials of this design, with the exception that the veil in front of the altar disappeared, the ciborium became a protective covering to the pyx in which the sacrament was reserved, and the altar was robed with a frontal and fair linen cloth over its top. The curtains round three sides in the form of a dorsal still remained to enshrine the altar and, together with riddles, were hung from the rods between the uprights at the four corners. The beautiful idea of protecting and dignifying the altar and pyx led to the use of testers, or hanging canopies, adorned with colour and symbolism. A modern and interesting example of this is the design for the high altar at St. Monica's Church, Bootle. The high altars of St. Cyprian's, Baker Street, and the John Keble Church at Mill Hill, are charming and liturgical examples of the English altar.

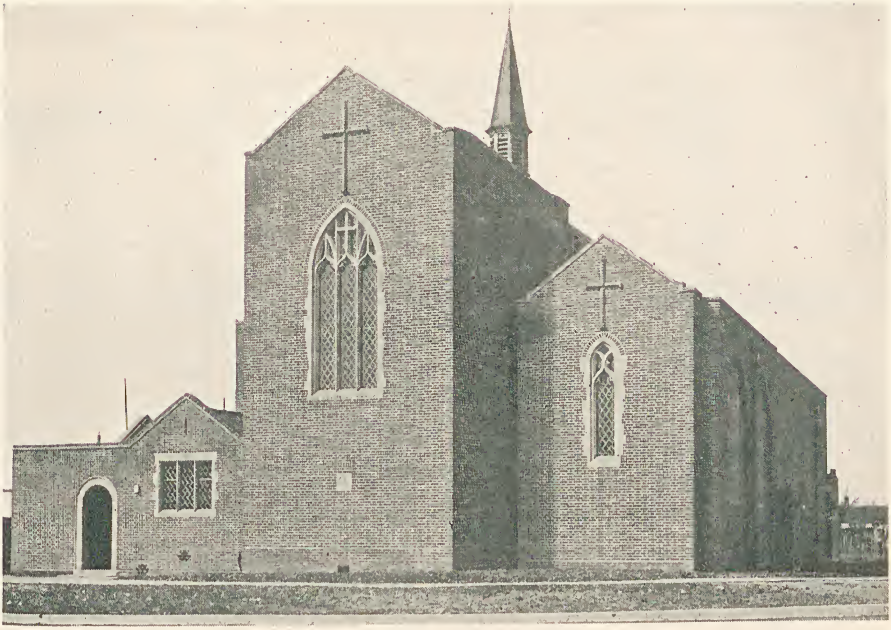


Fig. 6.—CHURCH OF THE HOLY TRINITY, WOTTON ST. MARY WITHOUT, GLOUCESTER

Exterior and interior. Particulars of construction, etc., are given on the next page. (*Architect : H. Stratton Davis, F.S.A., F.R.I.B.A.*)

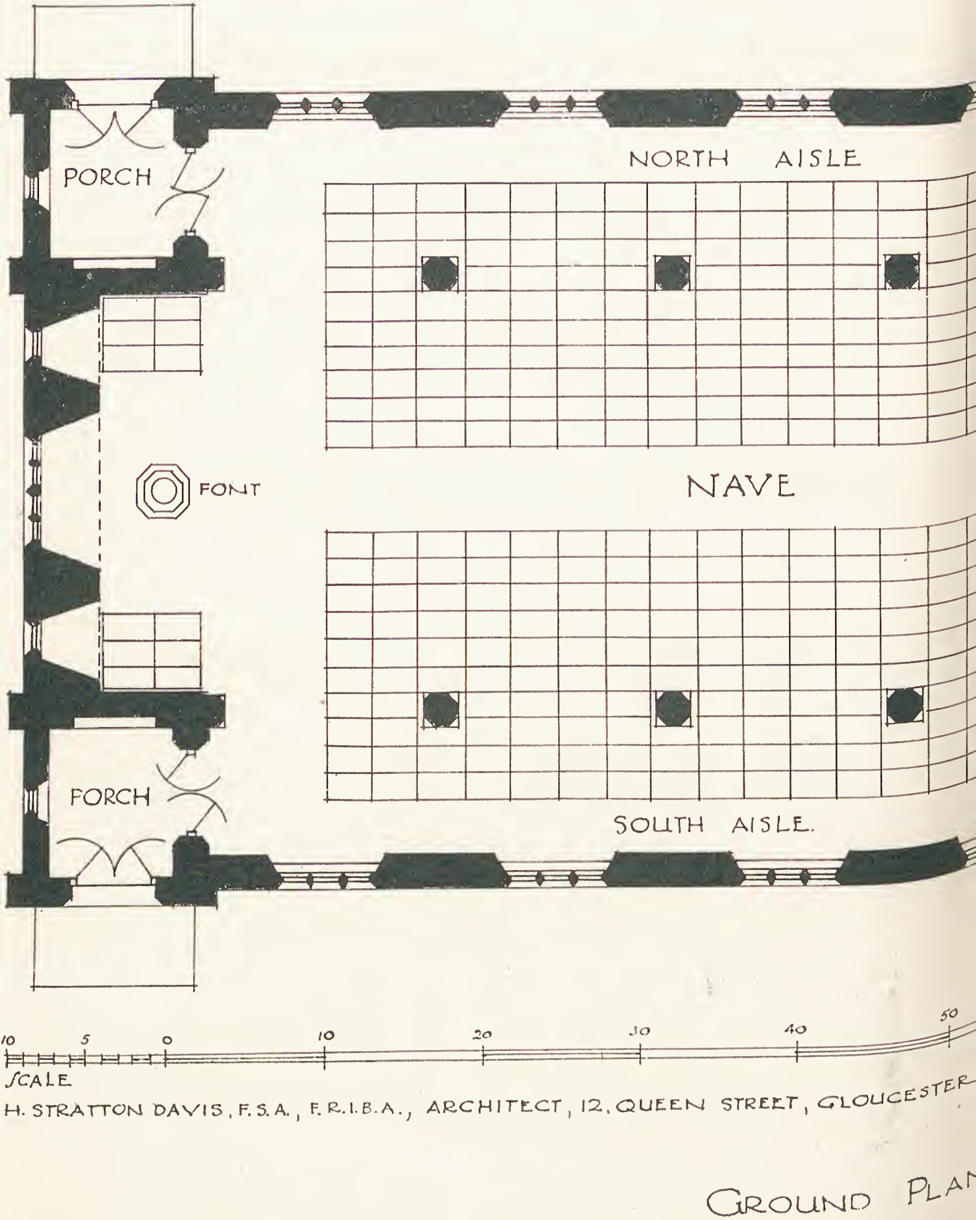
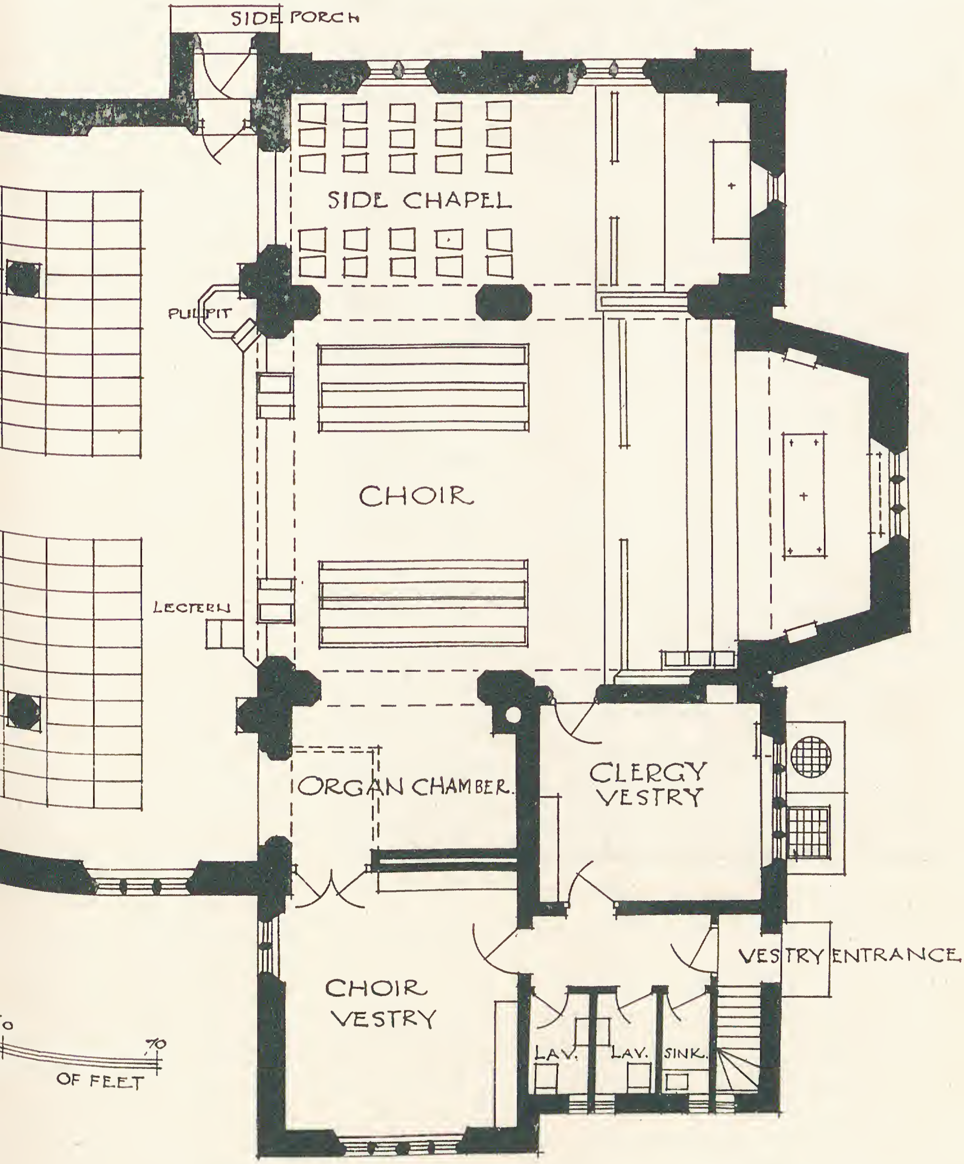


Fig. 7.—Church of the Holy Trin

The building accommodates 450 persons and cost about £11,000. The walls are faced with C
covered with Old Delabole slates. The internal walls are plastered, the plaster being left its natural



N ST. MARY WITHOUT, GLOUCESTER

-made bricks with wide grey joints, and the stone is from the Guiting quarries. The roofs are
e ceiling ribs are painted blue, and the panels are of "Tentest" board.

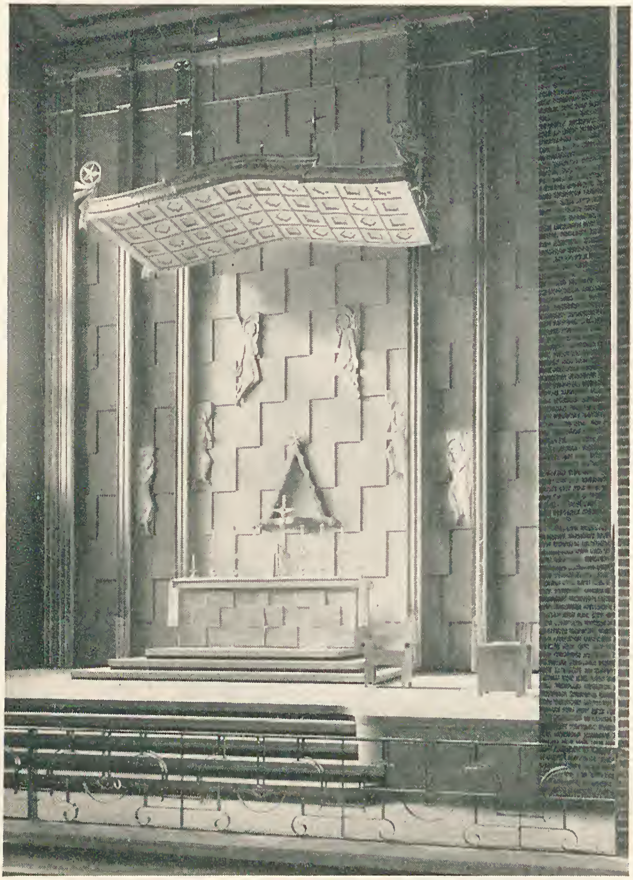


Fig. 8.—ALTAR, ST. MONICA'S, BOOTLE

A modern and interesting example of the idea for protecting and dignifying the altar and pyx by the use of a hanging canopy adorned with colour and symbolism. (*Architect : F. X. Velarde, F.R.I.B.A.*)

The Sanctuary

The successful design and planning of the sanctuary is in the first place dependent upon a clear appreciation of the order of the Church's services and ritual. These are mainly twofold : firstly, the Catholic Mass or the Protestant service of Holy Communion, in which the participants are the celebrant priest or minister, and his attendants, on the one hand, and, in the case of the Protestant rite, the communicants on the other. Secondly, the order of Confirmation, in which the bishop and confirmation candidates take part. As both services involve dignified ceremonial in which a considerable number of persons is engaged, the provision of open space unencumbered by furniture is very desirable. The sanctuary in many modern churches is frequently too cramped and confined ; it should never be less than 18 ft. to 20 ft. in width. It is necessary to emphasise the importance of spaciousness in the sanctuary, the easy transference of levels, and the conception of an ideal setting for those engaged in the reverent drama of the services of the Church. The present tendency to accommodate the choir either in a gallery, or at the head of the nave seating, has much to commend it, especially in releasing valuable open space at the eastern end of the church. The design of steps and levels is subject to no traditional ruling, but rather to the

Fig. 9.—CHURCH OF THE HOLY TRINITY, WOTTON ST. MARY WITHOUT, GLOUCESTER

View from the side chapel, showing altar. See also Figs. 6 and 7. (*Architect: H. Stratton Davis, F.S.A., F.R.I.B.A.*)

designer's innate sense of proportion. The plans here shown indicate various solutions to the design of the chancel levels. In further explanation of these it may be said that in no case should steps exceed 5 in., still better 4 in., in rise, and they should have a tread depth of no less than 18 in. To avoid inconvenience at the altar rail there should be a minimum space of 5 ft. between the ends of the stalls, where these are placed in the chancel, and the riser face of the communion step. Good planning demands a double return way from either end of the altar rails to the nave. A distance of at least 5 ft. between the riser face of the lowest step to the altar, and the communion rail, is necessary for free and safe movement to the celebrant and his assistant on special occasions.

The Altar Rails

It is important to secure as great a length as possible for the altar rails in order to ensure a reverent and easy administration of the sacrament. The design of the rail itself may be in the form of an open balustrade, 2 ft. high from the step or kneeling-board to the top of the rail, or the whole may be treated as a dwarf wall faced with fine material such as travertine or marble. The open rail enhances the effect of space to the

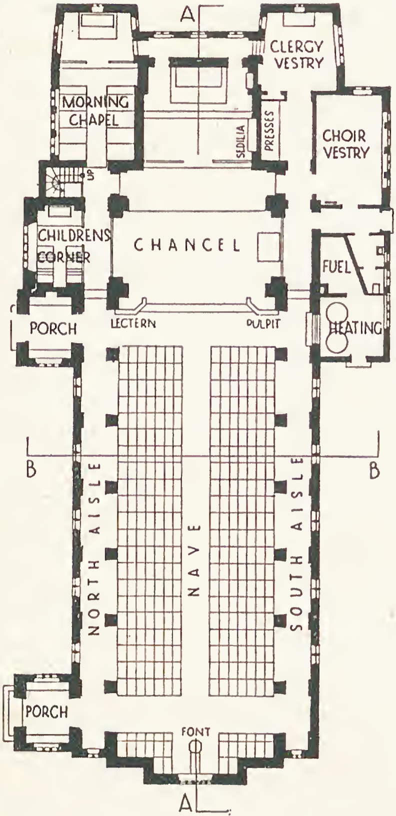


Fig. 10.—ST. THOMAS'S, HANWELL

Excellent example of vestry planning. (*Architect: Edward Maufe, M.A., F.R.I.B.A.*)

floor of the sanctuary. In some churches removable kneelers placed in an unbroken length across the sanctuary, with kneeling-boards hinged to fall inwards, and with a sloping top-rest 4 in. wide, have been used. These can be easily stored away when not required.

The rails or kneelers should be rigid; this is best secured, in the case of rails, by the introduction of rag bolts at intervals fixed into the concrete and secretly housed into the base frame; this should be allowed for when designing the floor finishes. Kneelers can be weighted at the base to effect this end. Kneeling-strips of Donegal fabric or other materials, dyed in harmony with the scheme of decoration, are necessary adjuncts. The rails or kneelers should be set back not less than 12 in. to 14 in. from the front face of the kneeling-step.

The Piscina, Credence, and Sedilia

These elements may be effectively united in one design, and occupy a position on the south wall of the sanctuary, or in other words on the right-hand side of the altar. The piscina consists of a small, cupped stone slab with a drain hole leading into a $\frac{1}{4}$-in. copper pipe which is connected to a dry well beneath the sanctuary floor. Down this the water used for the ablutions at the altar is poured and finds its way into consecrated ground. A credence table or shelf, about 14 in. to 16 in. square, on which the sacred vessels can be placed, should be adjacent to the piscina. The sedilia or seats for the celebrant and his assistants may be designed to stand forward as an independent piece of furniture, or, better still, as seats planned within the depth of the main wall.

The Choir

A church choir generally consists of twenty-eight to thirty-two choristers, made up of twelve men and sixteen to twenty boys. There are many positions in the church where the choir seats could be conveniently placed. That most generally accepted is on either side of the

chancel, distant about 10 ft. apart, and raised one step on oak-boarded platforms, with seats for six men and eight boys on each side. In this case the over-all measurements of the stalls should be 12 ft. in length, and from a minimum of 6 ft. 6 in. to 7 ft. 6 in. in depth. The two clergy stalls usually required are brought into alignment with the choir seats, and separated from them by an access way 2 ft. wide.

In many cases the choir and organ are placed in a gallery at the west end of the nave, a position often justified on musical grounds. There are, however, many disadvantages to this plan. In the first place, a well-ordered gallery plan demands a central position for the organ, which thus obstructs the main source of light from the west window of the church. Further, the design of a cantilevered gallery is seldom happily contrived, and often spoils the proportions of the church. There are other disadvantages, such as difficulty in securing silent and orderly access to the gallery, proper supervision of the choir, and the separation involved between the gallery and the vestry accommodation. With imaginative planning and design, however, these difficulties can be happily resolved, and a singers' gallery at the west end, or, indeed, elsewhere in the church, can offer an interesting solution to the problem.

The John Keble Church, Mill Hill, presents a new departure in the planning of the choir. Here the stalls are planned in two rows on either side of a central space formed within the central block of the nave seating. Return stalls facing the altar are provided for the clergy. This plan, although in many respects a very interesting one, seems to invite criticism with regard to the close and rather awkward juxtaposition of the first six rows of the nave seats and the choir stalls. The same applies to the position and orientation of the clergy stalls in relation to the nave seats, especially in the front, where the congregation have their backs turned to the clergy. Criticism in this case, however, is premature, as the church is not yet completed, and this new interpretation may yet be fully justified.

At St. Christopher's, Withington, Manchester, the choir stalls have been planned in short rows of four benches on either side at the head of the nave seats, an arrangement, so far as is known, without precedent. This plan considerably reduces the extent of floor area generally devoted to the choir, and permits of increased space in the sanctuary.

The Organ

The organ should be so placed that the player can both hear the instrument and supervise or direct the choir effectively. The substitution of electric for pneumatic action makes it possible to separate the manual from the pipes. Church organs are of two kinds: either the "straight" organ, or the "extension" organ. In either case a three-, or even two-, manual instrument with a maximum pipe length of 16 ft. will generally meet most needs. A two-manual straight organ covers a

Fig. 11.—SANDERSTEAD CONGREGATIONAL CHURCH
See also Fig. 11A. (*Architects : Smee & Houchin, F/F.R.I.B.A.*)

Fig. 12.—WEMBLEY PARK FREE CHURCH
See also Fig. 12A. (*Architects : Smee & Houchin, F/F.R.I.B.A.*)

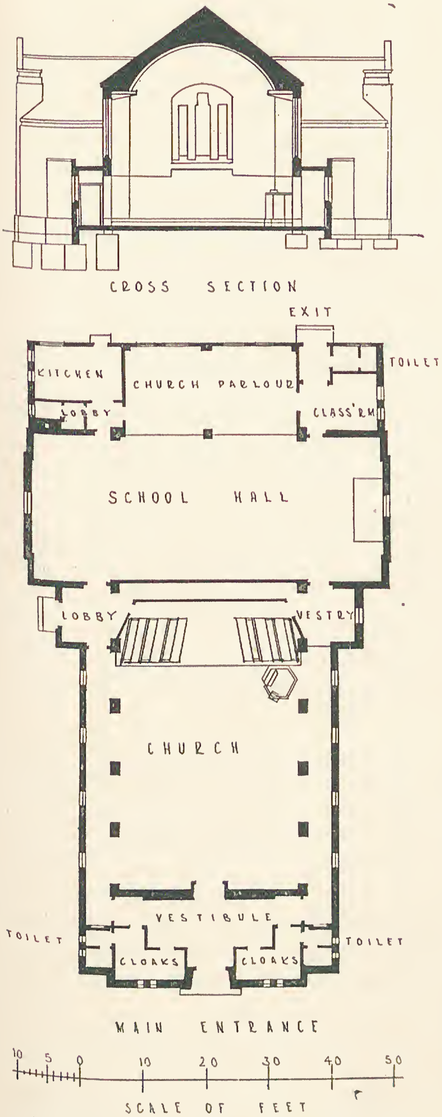


Fig. 11A.—CONGREGATIONAL CHURCH, SANDERSTEAD

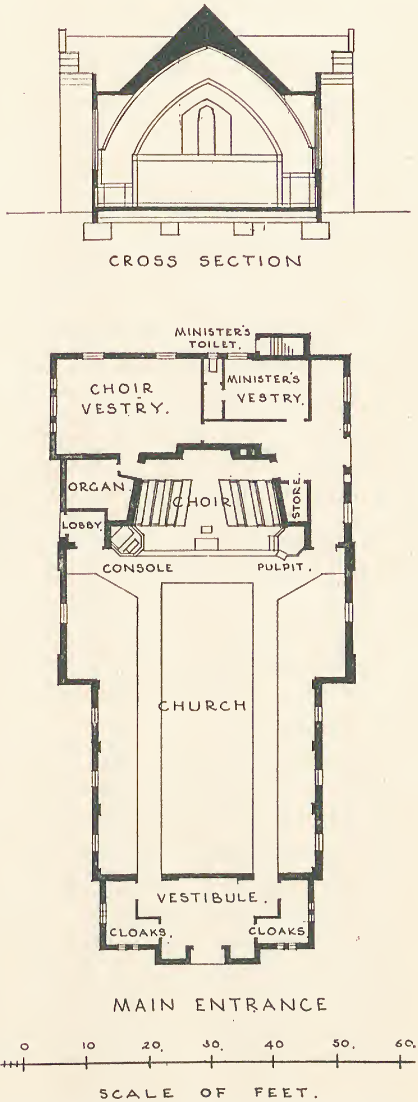


Fig. 12A.—WEMBLEY PARK FREE CHURCH

See also Figs. 11 and 12. The feature of the design of the Congregational Church at Sanderstead was to meet the problem of a church to seat about 250 and a hall to seat 250. The nave section, with a temporary wall at the transept end, forms the church, and the transepts form the church hall. The problem of the organ chamber was solved by building twin chambers in the last bay of the nave, operated by console control. The windows in the temporary wall are glazed with cathedral glass, silvered on the inside, and which, receiving the light from the window at the "west" end, give the illusion of external windows. The artificial lighting is by cornice lighting.

space 12 ft. square, with a height of 16 ft.; the extension organ 9 ft. square, with a height of 14 ft. The organ space should not be too confined, and should be planned to allow of access all round the instrument, and with as much height as possible. Where the organ is enclosed, two sides of the enclosure should be open to the church, and the space ventilated, and also warmed by an electric-panel radiator. The walls and ceiling enclosing the organ are better finished smoothly in Keene's cement, and the floor with boards or wood blocks. The organ grille often proves an interesting problem in design; a wood-framed grille faced with pierced plywood in different thicknesses, and painted attractively, can be a welcome addition to any church.

The Pulpit and Lectern

A distaste for temporary expedients, and the need for economy, have imposed strict limitations to the design of the pulpit and lectern, hence the present tendency to balance and unite them to the fabric. This is unfortunate, as each is well worthy of independent expression. The pulpit and lectern are best placed in front of a broad pillar, or at the intersection of two main walls. Small sounding-boards of the kind familiar in churches are almost useless. It is usual to raise the floor of the pulpit about 3 ft. above that of the nave, or even less. The internal size need not exceed 3 ft. by 2 ft. 6 in., and the height of the balustrade 3 ft. The lectern platform need not be raised more than 2 ft. above the nave-floor level.

The Vestries

The plan of the vestries is subject to logical interpretation of the needs of the particular church. The detailed planning, therefore, deserves more study than it usually receives. There should be two vestries: one for the choir, about 220 sq. ft. in area, large enough for parochial meetings; and a clergy vestry about 150 sq. ft. in area. Both vestries should be provided with robe cupboards and a separate lavatory, and should have easy access from the vestry porch. It is well to include a sacristy (about 120 sq. ft.) containing a frontal case, cupboards, and presses to contain the fair linen, vestments, and ornaments of the altar. Access either independently or from one to the other of these rooms should be possible without entering the church. Either the clergy vestry or the sacristy should be near, and accessible to, the altars in the church, so that the altars can be vested without crossing the chancel. A small flower room with a sink, a space and cleaning cupboard for the verger, and a storeroom are useful additions. The vestry planning at St. Thomas's, Hanwell, and the John Keble Church, Mill Hill, afford excellent examples.

Side Chapel

A side chapel for weekday services is necessary to all but small country churches. It should be provided with a separate porch, and usually

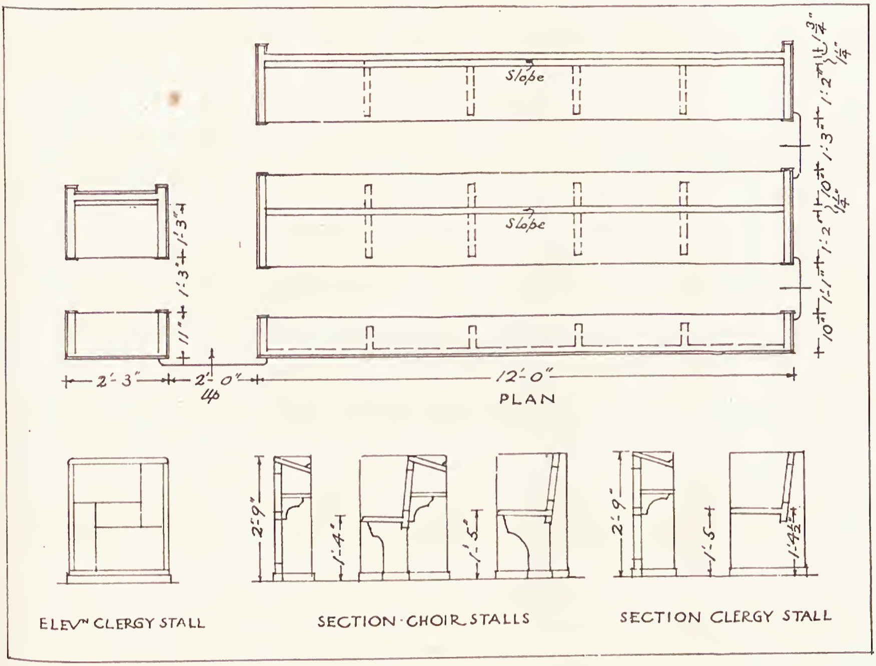


Fig. 13.—PLAN AND SECTION OF CHOIR STALLS

contains seats for from sixteen to thirty persons, according to the size and needs of the church it serves. The altar to the chapel, seldom more than 5 ft. to 6 ft. long, is placed in a small sanctuary the floor of which is raised one step to the altar rail, and one step to the foot-pace of the altar. Vistas created between church and side chapel can greatly enhance the charm of a design. The decorations of the church should be harmoniously reduced in strength and scale in the chapel.

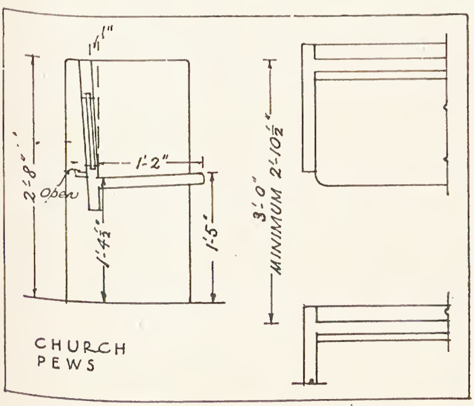


Fig. 14.—PLAN AND SECTION OF PEWS

The Font

As a sacramental symbol the font ranks next in importance to the altar at the east end, and is, therefore, generally the focus at the opposite, or west, end of the church. It should be so placed that it is immediately

apparent on entering the church. Formed usually of stone or marble, and raised one or more steps above the main-floor level, it should be designed in subtle harmony with the church in which it is placed. The diameter of the bowl should be about 2 ft. 6 in., and the font should be 3 ft. 9 in. high from the level of the top step. Standing-space for the officiating priest should be formed out of the top step on the west side. The inside of the font bowl should always be lined with lead or copper, and in accord with the accepted rule, "be provided with a plug and waste pipe to a dry well not connected with any drain." A font cover of either plain or ornate design is essential. The design of the font and its cover is subject to endless variety and interest.

The Nave

The nave should be planned with ample passages and exits for the convenient dispersal of the congregation. The central passage should never be less than 5 ft. wide, but wherever possible a width of 8 ft., to allow of an emergency, and removable row of chairs at either end of the main seating, adds greatly to the dignity of the nave. Side passages should not be less than 3 ft. 6 in. wide, although 5 ft. is better, as a procession in one form or another is more widely accepted to-day. For this reason, and on other grounds, a complete and independent circulation to the church passing either behind, or in front of, the altar and sanctuary is desirable. Passages and seats should be opened out to form a space round the font. A section of a church pew together with a diagram plan representing the minimum requirements sanctioned by the Incorporated Church Building Society is here shown. The Society further requires that "in setting out the lengths of pews 1 ft. 8 in. must be allowed for each person, and no pew must be more than 20 ft. long, and all over 10 ft. must be open at each end." Allowance also must be made for the thickness of pew ends. Where chairs are used they should be secured in rows of five or six by a continuous batten fixed to the under side of the seats.

Porches

Porches in the form of mean little lobbies appearing as pimples on the outside of the building are sometimes met with in cheap churches. There should be at least one roomy porch, and in all cases inner and outer doors should be provided. For convenient egress there should be a porch, or porches, to serve the back and front areas of the nave seating.

Types of Plan

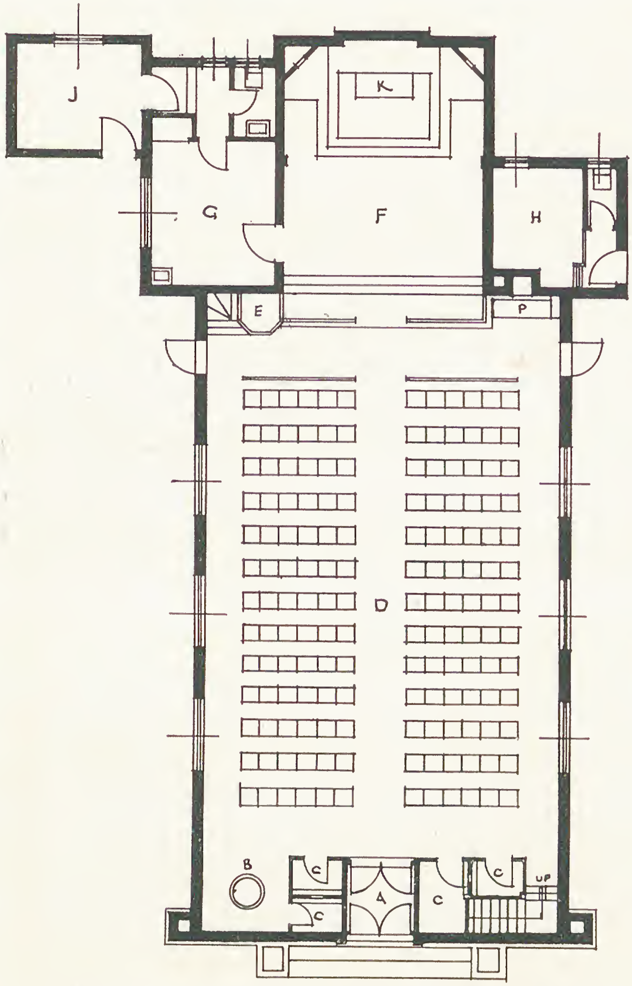
Types of plan are so varied and numerous that space will not permit of more than a general reference to them. Briefly, they may be resolved as plans largely dictated either by precedent, or by special conditions arising out of the nature of the site, or by a fresh interpretation of function.

Fig. 15.—CHURCH OF OUR LADY OF VICTORIES AND ST. BERNADETTE, ENSBURY PARK, BOURNEMOUTH

The facing bricks are Phorpres rustics with recessed joints, and the roof is covered with local hand-made tiles. (*Architects : Jackson & Greenen.*)

Fig. 16.—INTERIOR OF CHURCH OF OUR LADY OF VICTORIES AND ST. BERNADETTE

Walls finished above brick plinth with rough-textured cream-coloured plaster. Roof covered with "Tentest" sheets. Finished colour French blue with groups of silver stars stencilled on. Lighting in the ceiling itself in the form of recessed bulkhead lights in which is incorporated a star design. Central crucifix suspended from ceiling. Central heating by gas-fired boiler. Cost £2,100, exclusive of pulpit, altars, and furnishing.



KEY

A. Porch.
B. Baptistery and font.
C. Confessional boxes.
D. Nave.
E. Pulpit.
F. Chancel.
G. Vestry.
H. Boiler chamber.
J. Choir boys.
K. Altar.
P. Small altar.

Fig. 17.—GROUND-FLOOR PLAN, CHURCH OF OUR LADY OF VICTORIES AND ST. BERNADETTE

To seat 150 people. At the west end is a gallery which accommodates the choir and organ, with baptistery and confessionals placed under the gallery at each side of the entrance. The main body of the building is steel-framed with steel roof trusses.

The two latter types, freed from traditional dictates of form, are always the more interesting, as, for example, St. Columba's, Scarborough, St. Wilfred's, Brighton, St. Columba's, Anfield, and the John Keble Church, Mill Hill.

Whatever the form of plan, the simpler it is the better. The form of a large open hall of equal width and height throughout, rectangular in shape, and with low passage aisles and adjuncts, has much to commend

Fig. 18—ALL SAINTS' EPISCOPAL CHURCH, HILTON, ABERDEEN—RELYING FOR ITS EFFECT ON SIMPLICITY OF FORM, DIGNITY OF PROPORTION, AND RESTRAINT OF DETAIL

Fenestration is unusual. The nave is entirely devoid of clerestory lighting, but is lit from a horizontal line of windows in the aisles. The transepts and chancel walls are pierced by narrow windows of great height. Interior finished in rough-textured plaster. The source of light at the altar is invisible to the congregation, as it is screened by arches at the intersection of the nave and chancel. The high windows flood the chancel with light and throw this into relief against the comparative dimness of the upper unlit walls of the nave. (*Architects : A. Marshall Mackenzie & Son.*)

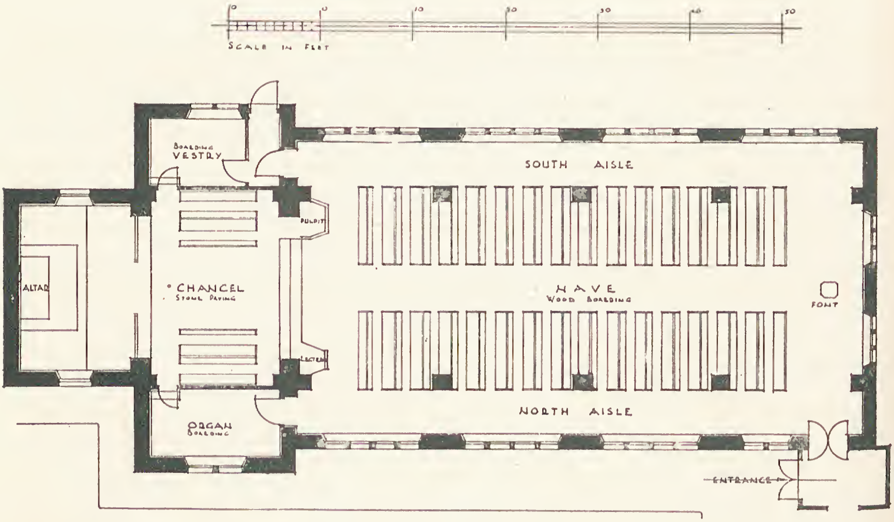


Fig. 19.—ALL SAINTS' EPISCOPAL CHURCH, HILTON, ABERDEEN—PLAN
(*Architects : A. Marshall Mackenzie & Son.*)

it. The whole question of the general type of plan most suitable is, however, open to the widest latitude.

Heating and Ventilation

Effective insulation to the fabric is the first essential to the heating of a church. Where this is inadequate, especially to the roofs, cold down drafts will be likely to occur. The available methods of heating a church are : (*a*) by hot-water boiler pipes and radiators with a low-pressure system ; (*b*) hot-water panels protected by asbestos, thermostatically controlled, and concealed behind the plaster where this is used. This method is expensive ; (*c*) electric tubular heating with heaters fixed on the floor beneath each row of chairs, and radiators, a system that at present is costly to maintain, but on the other hand dispenses with the necessity for a basement, chimney, and certain labour costs in preparation ; (*d*) warm air by a pipeless system by means of heaters, fresh-air inlet, and warm-air ducts. This system is inexpensive to install, but wherever used it should be augmented by electric or other means of warming to chapels and vestries ; (*e*) floor heating, which dictates the nature of the flooring material. It is not possible here to enter fully into the merits or demerits of any of these methods. Whatever scheme of warming is adopted, the chapels and vestries should be independently controlled, and some means of heat should be located near porches and high windows so as to warm any cold air entering the building. Means of ventilating a church other than by the windows is desirable.

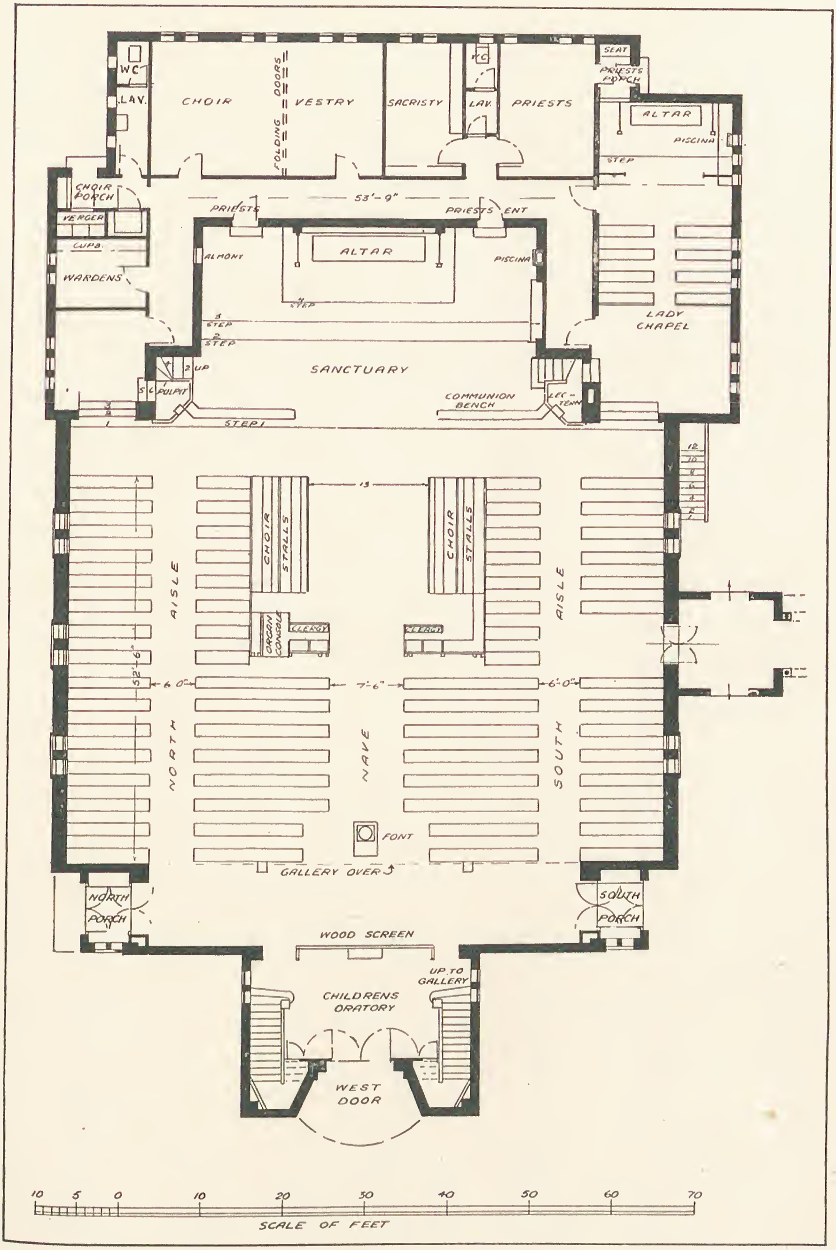


Fig. 20.—JOHN KEBLE CHURCH, MILL HILL, MIDDLESEX. GROUND-FLOOR PLAN
(*Architect: D. F. Martin-Smith, A.R.I.B.A.*)

An architect is occasionally engaged in settling a dispute between parties in the guise of a valuer: in this capacity he exercises his own judgment on facts put before him; he is not bound by statute law or by rules of evidence, and he is liable in negligence if he does not exercise such skill and knowledge as might reasonably be found among his confrères; on the other hand, in arbitration proceedings he is bound to decide upon the evidence adduced before him, and he is not liable in negligence.

The Arbitrator's Job

The arbitrator is bound by the terms of the submission to arbitration; it may arise in one of two forms: first, the submission may be that contained in the particular contract wherein he is nominated; secondly, it may be in a form agreed between the parties making a scope larger or less than the ordinary contract submission. The dispute may be larger than the contract visualises by bringing in parties other than the employer and contractor, and it may be less because the issues have been narrowed down between the parties by negotiation.

Whatever the terms of the submission may be, the arbitrator is bound by them; he must settle the differences so far as they are submitted to his arbitrament, and he would be extremely unwise to adjudicate upon any extraneous matter, even although the evidence may touch upon it, unless the terms of the submission are, by agreement between the parties, enlarged.

Appointing an Arbitrator

Submission is an agreement by which the parties refer an existing or possible future matter in dispute between them to the judicial and final determination of a named or designated third person. An agreement to refer a dispute to arbitration where no arbitrator is named or designated may be enforced by the Courts, but it is the more usual procedure to name a person and, in case he cannot or will not act, to designate another or the means whereby another may be found.

The Arbitrator's Award

The award is the result of the labours of the arbitrator, and the award together with the submission constitute a complete contract; a contract which can be completed in some cases with greater celerity than can a judgment be obtained in the High Court, and with the advantage that it is a decision by a person selected by the parties for his particular knowledge of the technicalities of the subject matter. There is also a further advantage—that of holding the proceedings in private as distinct from the publicity of the Law Courts.

An award is generally intended and is sometimes expressly stated to be "final and binding" as between the parties; there is normally no appeal from it when it complies with the law, and English law has always

attached the greatest weight to such sanctity of contract. If two parties in difference with one another agree to refer their dispute to a named or designated arbitrator, the Court will enforce his judgment on the ground that they selected their own tribunal, well knowing its limitations ; but on the other hand persons cannot agree to oust the jurisdiction of the Courts, and if the arbitrator has not given a fair deal the Courts will hear the parties and endeavour to remedy any apparent miscarriage of justice.

The Arbitration Act of 1889 assists the parties who have agreed to refer their disputes by providing that, where there is an agreement to refer, legal proceedings may be set aside until such time as the arbitrator has adjudicated upon the matter.[1]

Procedure

Assuming that the submission is in perfect order, the first task of the arbitrator is to dispose of preliminary matters, so as to get clear-cut issues put before him when he actually enters on the reference ; it may involve the ordering of pleadings by the parties consisting of a statement of claim, a defence thereto together with a counterclaim, and reply thereto ; or it may be possible to clarify the issues in the two first named only.

He will probably hear the parties or their solicitors at a preliminary meeting, and when the issues are roughly outlined it may be apparent that pleadings can best clarify the subject matter in such a way that the nature of the evidence to be adduced can readily resolve itself, as also which documents will be required to assist counsel or witnesses in presentation of the case.

Generally the pleadings and relevant documents are sent to the arbitrator and he is asked to fix a date convenient to him to enter on the reference. He may then give notice of place, date, and time, and in some cases, particularly after frequent adjournments, he may find it expedient to say he will proceed even if only one party is represented ; this is a form of castigation to a party who, by frequent postponements or for some other reason, endeavours to frustrate the authority of the arbitrator by refraining from putting in an appearance. This special notice is given in observation of the general rule that an arbitrator should not see or hear one party in the absence of the other ; justice should not only be done but should also appear to be done.

In some arbitration matters the law may seem the most important consideration ; in others, technical details may be of the greater consequence, but on occasions both these elements may be conspicuous. Where technical matters are in jeopardy, an architect, a surveyor, or an accountant may be the best judge because of his specialised knowledge. Where, on the other hand, legal documents have to be construed, probably the choice of the parties will fall upon a lawyer.

[1] Arbitration Act, 1889, 52 & 53 Vict., ch. 49, sect. 4.

Technical and Legal Assistance for the Arbitrator

Where a technical tribunal is appointed it may require guidance in legal matters, and similarly where a legal tribunal is appointed it may require assistance upon technical matters ; the principle is well established in the High Court where upon Admiralty cases the Court has the assistance of a nautical assessor, and similarly the Official Referees may now in highly technical cases have the assistance of a technical assessor. The same principle extends to arbitrations, and by consent of the parties a technical arbitrator may select a lawyer to sit with him, or a lawyer may select a technical specialist to assist him, but whatever the procedure may be the arbitrator's judgment cannot be usurped and the award is his and his alone ; he may not delegate his functions, and he must fulfil them to the letter ; likewise, where there is more than one arbitrator the plural must similarly act except by agreement between the parties.

The costs of the employment of such assistance are in the discretion of the arbitrator, as are normally all other costs, and the employment of legal assistance either to advise on points of law or to draft the award, either interim or final, are likewise to be borne by the parties, apart from the arbitrator's own costs, and in the proportion he may determine.

Stating the Award in the Form of a Special Case

An arbitrator may be asked to state his award in the form of a special case when a question of law is involved ; this means that he gives his award in an alternative form : first on the law as he understands it, and then, if his interpretation of the law is found by the Court to be fallacious, in some other or varying form ; the employment of a legal assessor may help to avoid such findings and consequent expense, for an appeal on a point of law may be taken ultimately to the highest Court.

The arbitrator instead of giving his award in the form of a special case may, on occasion, say to the parties that he prefers to adjourn until the Courts have decided upon the obstructive point of law, and this has the advantage that his award has the finality which it was originally intended to have, and control of the matter is kept within the ambit of the arbitrator.

It not infrequently happens that, where an award is stated in the form of a special case, the grounds of contention vary considerably from those adduced before the arbitrator, and so that he may not lose control it may be prudent to invite counsel, or the parties if they appear themselves, to agree upon the precise terms of the matter upon which the guidance of the Court is to be evoked ; there can then be no dispute that the judgment of the Court is not in consonance with the relevant law, nor can the award be set aside as not being within the four corners of the submission.

When the Courts Will Set Aside an Award

The Courts will, in general, set aside an award for an error in law apparent on the face of it, but not for every error in law; if a specific point of law is referred to arbitration, and the award is appealed against, the Court may affirm it even although the Court would not of itself have so interpreted it.[1]

Though an award may be set aside for an error of law appearing on the face of it, and though a question of construction is, generally speaking, a question of law, yet where a question of construction is the very thing referred to arbitration, then the decision of the arbitrator upon that point will not be set aside by the Court only because the Court would itself have come to a different conclusion. If it appears by the award that the arbitrator has proceeded illegally—for instance, that he decided on evidence which in law is not admissible, or on principles of construction which the law does not countenance—then there is error in law which may be a ground for setting aside the award, but the mere dissent of the Court from the arbitrator's conclusion on construction is not sufficient for that purpose.[2]

General Rules of Evidence

It may not be the lot of all to sit in the arbitral chair, but on occasion one may be called upon to give evidence before an arbitration tribunal, and therefore a few points of the general rules of evidence may be of interest.

In every system of jurisprudence it is recognised that before a fact is accepted and acted upon it must be proved. Evidence is the foundation of proof, with which it must not be confounded; proof is that which leads to a conclusion as to the truth or falsity of alleged facts which are the subject of inquiry; evidence, if accepted and believed, may result in proof, but it is of itself not necessarily proof.

The rules and principles of law which govern the admission or rejection of evidence are numerous, and some are of extreme complexity; they arise partly by statute but mostly out of an enormous bulk of judicial decisions.

The late Lord Reading, in an important House of Lords case, said:—

> "It has been solemnly decided that there is no difference between the rules of evidence in civil and criminal cases. If the rules of evidence prescribe the best course to get at truth they must be and are the same in all cases and in all civilised countries."[3]

It may be that in the arbitration room there is sometimes a certain laxity as regards the rules of evidence, but the witness nevertheless might well bear in mind that his evidence should be given and examined with

[1] *Re* King and Duveen, [1913] 2 K.B. 32.
[2] Kelantan Government *v.* Duff Development Co., [1923] A.C. 395.
[3] R. *v.* Christie, [1914] A.C. 545 at p. 564.

the same care and scrupulous exactitude which one might find in an Old Bailey trial on a capital charge ; indeed, after a witness has taken the oath, if he wilfully makes a statement which he knows to be false or does not believe to be true he is guilty of perjury, and if guilty can be subjected to a maximum penalty of penal servitude or to hard labour.[1]

Evidence Tendered Must Be Relevant

Two rules of evidence are almost self-evident. They are : "The facts of which evidence is to be tendered must be relevant to the issue to be tried," and in this connection an arbitrator may hesitate before he interrupts a witness who rambles on upon matters not contained in the pleadings and totally irrelevant to the issues ; this probably more frequently happens when counsel do not conduct the case, but as costs are obviously increased by waste of time the moment may come when the arbitrator, strictly in the interests of the parties themselves, should remind them of the existence of this cardinal rule.

The Best Evidence Must Be Given

The second rule is : "The best evidence procurable must be given of the facts sought to be proved" ; thus, if proof of a contract is sought the original stamped document is the proper one to put in because a copy may not be an exact copy ; similarly, one would not expect a diary to be accepted as best evidence if the writer of the diary is still able-bodied and within the jurisdiction of the tribunal, for not only could he speak with authority as to his diary, but he could also be cross-examined on the circumstances wherein he wrote it.

A logical outcome of this second rule is that where the Court cannot have best evidence it will hear the next best or secondary evidence and, if the opposing party raises no objection, the arbitrator, on being satisfied that he is receiving the best evidence available, will give such weight to it as he deems prudent.

Hearsay Evidence

Normally, hearsay evidence is not of consequence in determining issues ; there may be exceptions, as, for instance, in favour of statements of deceased persons, statements contained in public documents, and as to matters of easement or right of way ; the underlying objections to hearsay evidence are that it may have been distorted in the retelling, that the person who said it cannot be subjected to cross-examination, and that it was not made on oath ; the demeanour of a witness as he gives his evidence may be of assistance to the tribunal to show whether his is a reliable story, and in the case of hearsay evidence this benefit of observation is denied to the arbitrator.

[1] See Perjury Act, 1911, 1 & 2 Geo. V, ch. 6, repealing sect. 22 of Arbitration Act, 1889, 52 & 53 Vict., ch. 49.

The Burden of Proof

The burden of proof of evidence lies generally upon the party who substantially asserts the affirmative of the issue; this rule is derived from Roman law, and is supportable not only upon the ground of fairness but also upon that of the greater practical difficulty which is involved in proving a negative rather than in proving an affirmative; thus it is more difficult to prove that goods were not dispatched on a certain date than to prove that they were in fact sent. Upon whom the burden of proof will lie is determined by the pleadings; he who makes the claim has to establish it by his evidence, and if he fails to do so the case should be decided against him, and the costs should follow the event.

The weight to be attached to evidence depends largely on common sense, and the factors that are taken into consideration in eliciting the truth vary in each case with the circumstances; tests which have been applied from time to time may or may not be suitable to apply in similar cases; thus, bias or interest in the subject matter is clearly of importance in estimating the weight of evidence: the evidence of an employee may be biased because of his employment; the evidence of an expert may have a tendency to be tinted by the spectacles of the side who engaged him.

Negotiation without Prejudice

The law has always been peculiarly tender in its treatment of efforts made by the parties to compromise their disputes, and it will exclude proof of negotiations entered into for that purpose either expressly or impliedly "without prejudice." Letters written in pursuance of an effort to settle the dispute are not admissible except by agreement between the parties, but the rule is strictly confined to cases where there is a dispute or negotiation and terms are offered for its settlement. Lindley L.J. expressed the matter thus:—[1]

> "What I understand by negotiation 'without prejudice' is this: Plaintiff or Defendant, a party litigant, may say to his opponent: Now you and I are likely to be engaged in severe warfare; if that warfare proceeds you understand I shall take every advantage of you that the game of war permits . . . but before bloodshed let us discuss the matter and . . . be more or less frank. We will try to come to terms and that nothing that each of us say shall ever be used against the other so as to interfere with our rights at war if unfortunately war results."

Documentary and Oral Evidence

The evidence to be submitted to an arbitrator may be either documentary or oral, and is provided for in the 1889 Arbitration Act,[2]

[1] Walker *v.* Wilsher (1889), 23 Q.B.D. 335 C.A. at p. 337.
[2] See First Schedule, Cl. F.

subject to no definite exclusion by agreement between the parties, thus :—

> "The parties to the reference and all persons claiming through them respectively shall, subject to any legal objection, submit to be examined by the arbitrator on oath or affirmation, in relation to the matters in dispute and shall, subject as aforesaid, produce before the arbitrator all books, deeds, papers, accounts, writings, and documents within their possession or power respectively which may be required or called for and do all other things which during the proceedings on the reference the arbitrator may require."

It may devolve upon an arbitrator to decide difficult questions as to the admissibility of evidence which is tendered before him. They may arise as to the competency of a witness to speak, to alleged facts, or the nature or materiality of evidence ; the arbitrator has to exercise his discretion, but an error on the materiality of evidence, if he rejects it, may involve the setting aside of the award or in a lesser degree in its being remitted back to him for his further consideration ; on the other hand he cannot be impugned for the receiving of immaterial evidence.

Expert Evidence

An arbitrator in highly technical matters has frequently to consider the evidence of experts : their knowledge is that which can be obtained only by special training or experience. In some cases, following Court rules, it is agreed that only one shall be called on each side, but if the parties care to submit more for cross-examination, the arbitrator is bound to hear them, in addition to witnesses as to mere fact. Expert witnesses are not to be heard on matters of law, but may fitly testify to assist the Court on matters of custom of trades or occupations or matters of which they have made a special study, but this last might not embrace such a subject as the construction of an Act of Parliament, and that might extend so far as by-laws made in pursuance thereof,[1] because such matters are only within the purview of the tribunal itself. The same principle applies to the construction to be put upon the clauses of a contract : no external evidence or expression of opinion is permissible to vary its terms, although fraud, or the non-performance of a condition precedent, as for instance failure to give possession of the site for a building, may be worthy grounds whereon to base a repudiation and a consequent claim in damages.[2]

[1] Camden (Marquis) *v.* Inland Revenue Commrs., [1914] 1 K.B. 641 ; Inland Revenue Commrs. *v.* Camden (Marquis), [1915] A.C. 241 H.L.

[2] Trollope and Colls *v.* Singer, Hudson, 4th ed. I. 849.

PLANNING AND DESIGNING A TYPICAL MODERN HOUSE

Fig. 1.—THE HOUSE, FROM THE ROAD

Showing its wooded setting, and the fall of the land towards the view to the north-east. The planning and design of the above house is considered in detail in the text.

IT is proposed in this article to consider a typical contemporary house in some detail, and so exemplify most of the principles of domestic planning and design which have been discussed in previous articles. "Open planning" and the importance of aspect were explained on pages 145 to 160. The article on pages 225 to 240 dealt with the architect's method of presenting his design, the significance of the specification, and the choice of materials. This was followed (pages 289 to 304) by a discussion on the architectural possibilities of grouped housing and housing schemes, with special reference to Welwyn Garden City.

A DETAILED STUDY

Even where large schemes are concerned the individual house should receive detailed thought in the matter of aspect, convenience, privacy, and, above all, æsthetic charm. It follows, therefore, that the present more intensive study of a particular house has a bearing on every

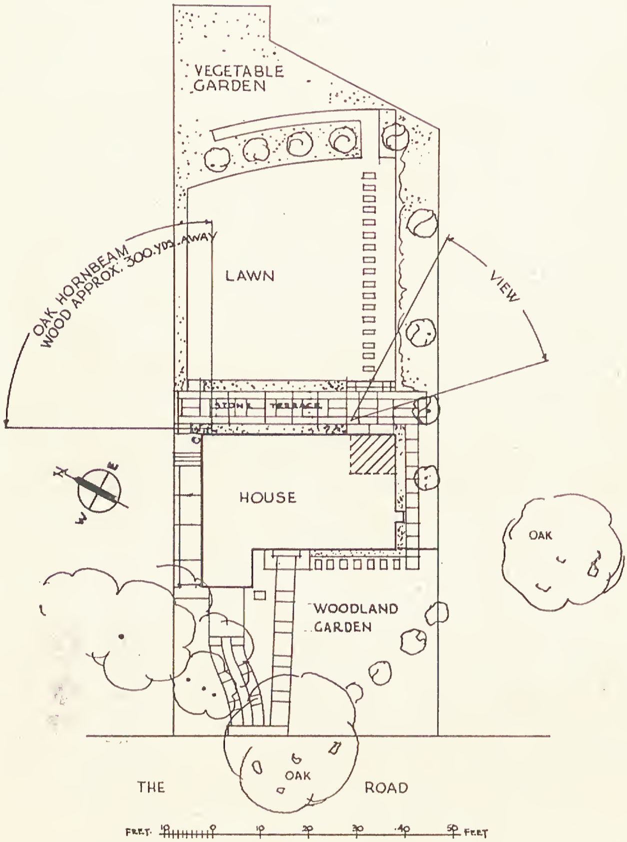


Fig. 2.—THE SITE PLAN OF THE HOUSE

type and branch of housing.

The Site

The site in question was chosen for the sake of its high situation, overlooking a fine view to the north-east. Meadows slope down from the house, and old hedges and woodlands provide a varied scene which stretches to the far hills on the horizon. In a north and north-westerly direction is an old oak-hornbeam wood on high ground, which serves as a screen from cold winds. The road is to the south-west of the site, so that the south-east aspect—usually considered ideal for dining-rooms and bedrooms—is to the side of the house, adjoining which it is intended to build another house.

View and Aspect

The first problem, therefore, was as to whether the view or the sunlight should receive first consideration. The choice was for the view, but it was realised that if an open plan with one large living-room were worked out it should be possible to produce an interior enjoying sun throughout the day. The dining portion of the room has a window facing north-east, and a glazed door to the south-east leading to a loggia which enjoys sun until midday. The sitting side of the room to the south-west is sunny from midday onwards. All bedrooms have windows facing the view and the morning sun, and the largest of them has also windows to the south-east and south-west. A cheerful kitchen was

Fig. 3.—THE HOUSE, FROM THE EAST
Showing the loggia and one of the sleeping-balconies.

Fig. 4.—THE ENTRANCE FRONT, SEEN FROM THE GARAGE APPROACH
The large sliding-folding sitting-room window is shown in its open position.

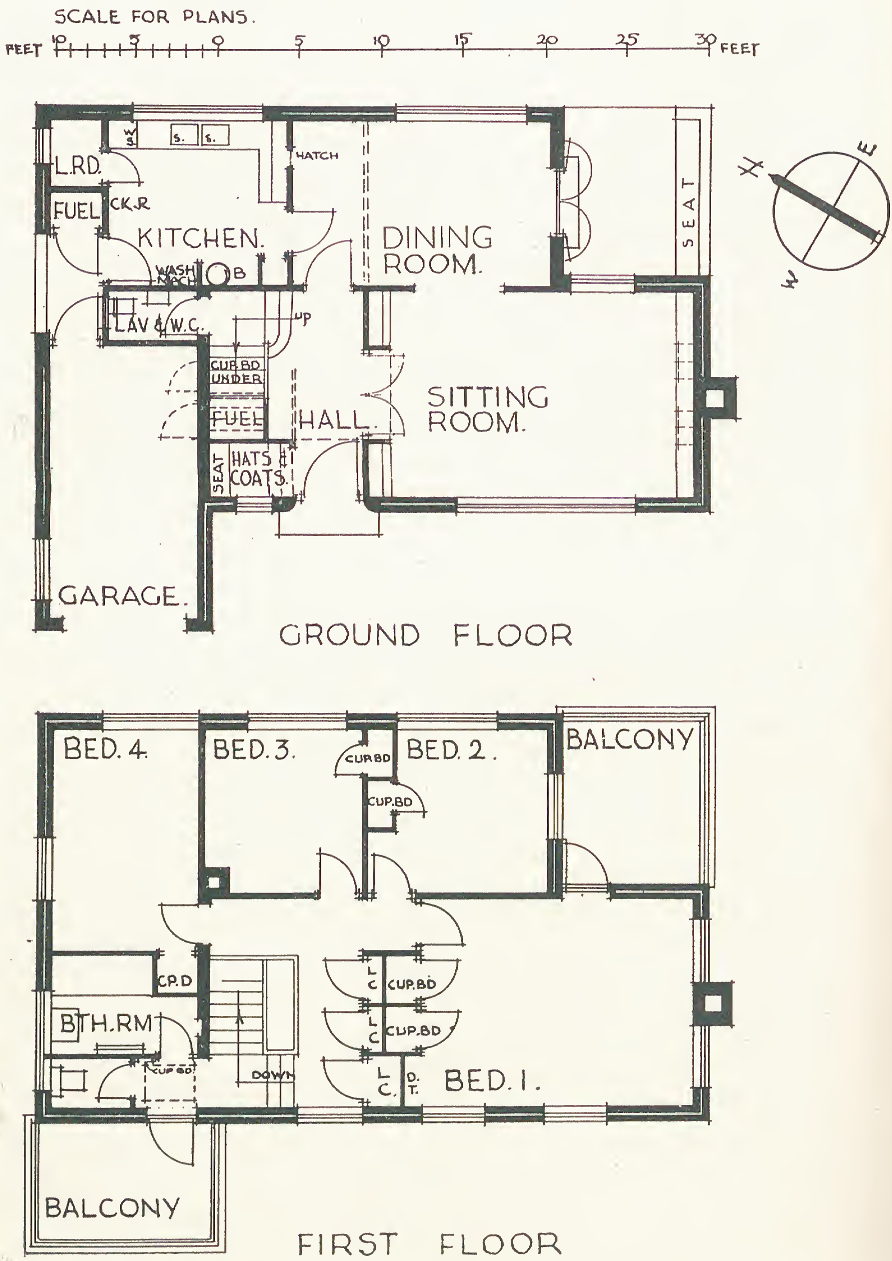


Fig. 5.—Ground-floor and first-floor plans

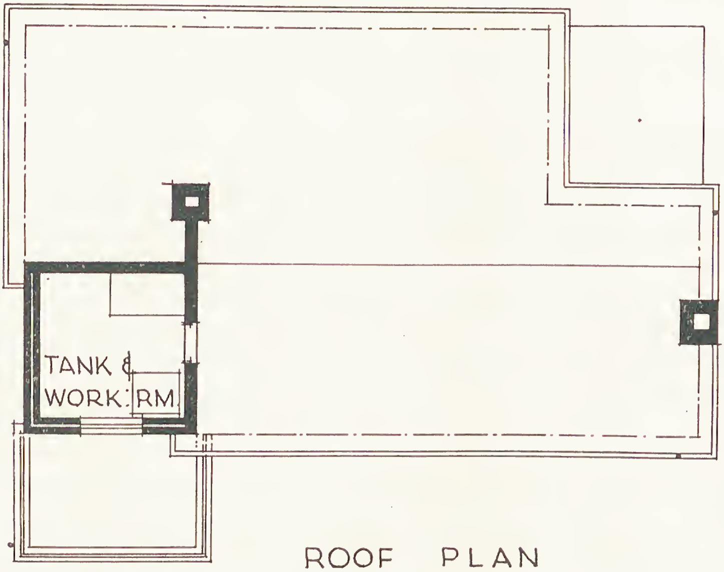


Fig. 6.—THE ROOF PLAN

considered important, and it enjoys an easterly aspect and a wide view through the large window.

The Requirements

As the architect was designing the house for his own use it might be thought that the arrangements and accommodation would be a simple matter to decide. It is, however, always necessary to know what essentials must be adhered to and what non-essentials—owing to cost and personal taste—can be dispensed with. The chief requirement for a really restful house of unobtrusive appearance is one which concerns finish more than accommodation, and it will therefore be dealt with later when these matters are discussed.

It was intended to run the house without a resident servant. Ease of service was thus in mind from the start. The kitchen adjoins the dining-room, and a service hatch in the back of the dresser facilitates the laying and clearing of meals. An open fire in the sitting-room is the only one in the house, and sufficient radiators to warm the whole interior are supplied from a boiler in the kitchen.

In the circumstances, it was decided that privacy as between one part of the ground floor and another could be dispensed with in the interests of sunlight and spaciousness. The bedrooms are, however, large enough to serve as studies, thus leaving the ground floor for more convivial occupations.

Sleeping Accommodation

The family of four required three bedrooms and a fourth for visitors. There are also two sleeping-balconies, each of about 100 sq. ft., in the east and west respectively. The largest bedroom approaches the former by means of a glazed door.

The usual lavatory accommodation consists of a lavatory with basin and w.c. off the lower staircase landing, a w.c. and bathroom off the upper landing, and a basin in the spare bedroom. The bathroom and w.c. are over the back portion of the garage, and the whole of the sanitary accommodation is thus at the north-west end of the house. This ensures not only economy in the matter of drainage work, but freedom from the noise nuisance in the rest of the house.

As the living-room is to serve all the needs of a young family, from children's games to wireless programmes, it was necessary to provide some retreat for any architectural work which might be done at home. For this purpose use has been made of part of the tank room over the bathroom.

In flat-roofed houses it is, of course, necessary to house the storage tanks above the highest water fittings. A bulkhead above the flat roof is therefore usually necessary. This can be extended to serve other purposes, such as storage or, in the present case, as a small study.

Living Accommodation

The "living" accommodation was to include: (1) a space for meals at a table to seat eight people; (2) ample sitting space around an open fire, bookshelves, wireless recess, and a writing-desk and space for a piano. As all these purposes were to be served in the same room it was necessary for it to be of a good size (20 ft. by 12 ft. 6 in.); (3) an ample staircase hall which could in summer be united with the living-room by opening the folding doors; and (4) an open-air room or loggia for meals and general use in summer.

The service accommodation was to include a garage with covered access from the kitchen, two fuel stores—for boiler coke and fire fuel, and a cloak recess off the hall, with a seat with boot-rack beneath.

The Shape of the Plan

It was found that the living accommodation resulted in a plan shape which could not have been roofed in a simple manner with the ordinary pitched roof, even if the architect had wished to adopt this type. Thus, though his preference for a flat roof was on æsthetic grounds, his choice might equally have been dictated by practical considerations.

THE EXTERNAL APPEARANCE

Having decided on the accommodation, the next step was to consider the setting and appearance of the house on the site. As there were a

Fig. 7.—THE FIREPLACE

This is of grey-buff quarry tiles, harmonising with the oak flooring, roughish plaster walls, and pulpboard ceiling.

Fig. 8.—THE LIVING-ROOM

With doors and curtain open to give an effect of spaciousness.

Fig. 9.—THE LIVING-ROOM
Doors and curtains closed.

Fig. 10.—THE DINING-ROOM, LOOKING TOWARDS THE LOGGIA

number of shrubs and a large oak tree which it was desirable to retain, the garage and front approaches were studied with these in mind.

As already mentioned, the placing of the house was dictated by the view to the north-east, and a further consideration was that any future house to the south-east should not overlook the loggia or dining-room. The house was set back 5 ft. farther than otherwise necessary from the road as a safeguard against this possibility.

For a house on such a wooded site it was thought that a flat roof would provide an effective contrast to the vertical lines of the surrounding trees. A further inducement in favour of a flat roof is that it makes it possible later, if so desired, to form a roof garden or additional sleeping-balconies.

Materials

Harmony with the surroundings was the main aim in the choice of building materials. Local yellow stock bricks, which soften in colour under the weather, were preferred to any red or multi-coloured material, since the latter are apt to clash with the tones of the vegetation. The guttering and down pipes are of copper, and will therefore in time take on a green patina which will contrast pleasantly with the brickwork. The wood frames and metal windows are painted externally a pale pea-green, the oak front door is oiled, and the garage and service doors are painted deep cream with a view to harmony with the brickwork. The balcony railing and grilles are of copper, and the copings to chimney stacks and to the tank tower are of grey-buff quarry tiles. The lintels over ground-floor windows project forward slightly as hoods throated on the soffit, and are, like all other exposed concrete surfaces, coated with " Imstone " of a deep " stone " colour.

Enough has perhaps been said as to materials to explain the appearance of the building by reference to the photographs. It might here be mentioned that though the building appears rather prominent and obtrusive in the illustrations, the object in its design was to make it harmonise modestly with its surroundings, and in this it succeeds fairly well.

THE INTERIOR

It cannot be too much emphasised that the modern home should be designed to give a restful atmosphere. This can be achieved as much by the right choice of colour and texture in the materials as by providing against sound transmission and reverberation.

Materials for Minimising Noise

On the latter score the floor joists used are rather deeper than required for structural reasons ; the ceilings are of a $\frac{1}{2}$-in. pulpboard undecorated (to minimise reverberation), and the oak staircase treads are nosed with rubber. One-and-three-eighths-inch " Heraclith " slabs are

laid on the roof joists, and the bitumastic roofing laid thereon. This serves as both thermal and sound insulation.

Colour and Texture

The keynote of the colour is the tone of untreated oak, which material is used for the floors, doors, architraves, skirtings, built-in furniture, and staircase panelling. The floors are in American oak, and all other work is in Austrian oak. For practical reasons the ground-floor boards have been treated with white wax, but only sufficient wax was used to render the surface easy to keep clean, and the intention was not to impart a polish to the wood. The bedroom floors have a dressing of a light colour so that they can be washed without the danger of the wood swelling. Apart from this, however, all the oak has been left its natural colour, and a perfectly flat colourless varnish has been applied to it so that finger marks can be removed easily.

The floor tiles in the vestibule, over part of the kitchen floor, in the fireplace, and on window boards are of a grey-buff of a tone similar to the oak. White gypsum plaster was used for the walls and given a scraped finish, which is slightly rougher than that left from a wood float. To obtain this finish it is necessary to use a setting coat of plaster gauged with sand, and the resultant colour is a pale buff which is in tone with the general colour-scheme.

The ceilings are, as already mentioned, of a thick pulpboard in large sheets with rebated V-joints. This type of jointing renders cover fillets unnecessary, and provides a pleasant surface. The colour is almost the same as that of the plastered walls. To obviate the cracking of plaster where it adjoins a boarded ceiling a small wood cove was fixed at the intersection of wall and ceiling, rebated for both. This cove is painted to match the general colour, as are the wood frames and metal windows. Hangings are as important as building materials themselves from the point of view of achieving a restful effect, and the window curtains on the ground floor were chosen to match the wall colour as closely as possible. An inexpensive "folk-woven" material was found which answers this purpose admirably.

An effect of restfulness and an enhanced spaciousness can be secured by studying both texture and colour in the way suggested above. These results are obtained in the present case by adopting the light grey-buff tone of oak and a roughish texture. There may be cases—as, for instance, a town house in a dusty street—where smooth or even shiny surfaces would have practical advantages which might outweigh the æsthetic disadvantages of a high polish.

It may seem that such a uniformity of colour would appear monotonous. This need not, however, be the case if bright colours are used for cushions, rugs, and possibly a few pictures. The latter must, however, be used with great care and restraint, and on no account be allowed to dominate

Fig. 11.—THE LARGE BEDROOM
Showing beds in an unusual position under windows.

Fig. 12.—THE LARGE BEDROOM, WITH DRESSING-TABLE AND WARDROBES

Fig. 13.—THE KITCHEN

The tiled walls and the cupboards are a light primrose colour, and the floor is of grey linoleum.

the scene. A few good pictures chosen for their contrast to the general tone may help, but many old treasures will probably have to be banished from the walls. Books and good flowerpots and vases also have a use in giving just the right kind of colour contrast. It must, however, be remembered that bright colours—or in fact any " incident " on which the eye may rest—should be placed low on the wall, and below eye level when possible. If the eye is caught by some feature in a high position there is a loss of the feeling of repose which a good interior should give. For the same reason, and for others which are obvious, window cills should be as low as possible.

The choice of the kind of wood used for the house will naturally influence one's selection of furniture, and it is also necessary to maintain the simplest shapes—consistent with comfort and usefulness—if the right effect is to be achieved.

The Living-room

Instancing these remarks by the case under consideration, it may be noticed that the only " picture " over the sitting-room fireplace is an old map—rather small, perhaps, for its position, but framed in oak which matches the rest of the joinery.

The pictures on the shelf are not very happily placed, but happen to

Fig. 14.—THE STAIRCASE, LOOKING DOWN

All the woodwork is oak, and the walls are of undecorated plaster of a roughish texture.

be of colours which provide a good contrast to the walls. The furniture has no special distinction but is simple enough to be unobjectionable. The shelf over the fire is only about 3 ft. above the floor, and is carried across the room, which enhances its effect. There is a shelf for a few often-used books beneath it, and cupboards for the more untidy things such as mending-baskets. The window is of the "sliding - folding" type, four lights of which can be opened completely on sunny days. For ventilation in cold weather there is a top-hung ventilator at each end. The bright oriental rugs and cushion covers provide the main contrast in colour.

Views of the other end of the room are given with doors and curtain both open and closed, showing the summer and winter arrangements. The sitting-room fittings already referred to are recessed in the wall, the writing-desk to the left, and the wireless set, with gramophone records cupboard beneath, to the right. Above the built-in bookshelves are cupboards for old papers, cameras, and seldom-used books, and for electric fuse-boards and meter. These cupboards are of birch plywood, and are flat-painted to match the walls. The reason for this treatment in preference to oak is that the latter would tend to catch the eye and give a rather unrestful effect at so high a level.

The hall is seen beyond, and the dining-recess to the right. The cur-

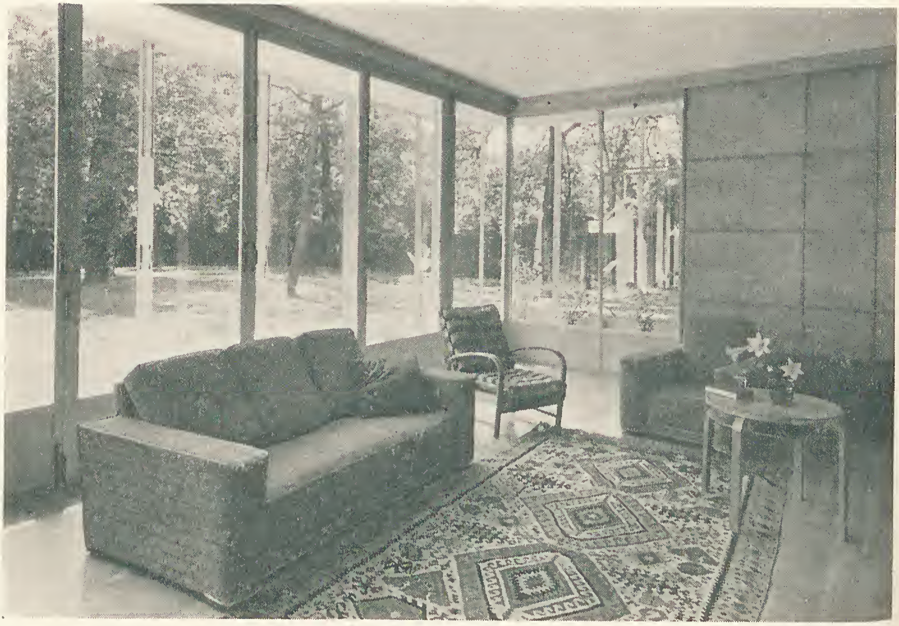


Fig. 15.—LIVING-ROOM OF HOUSE AT WIMBLEDON
Note double glazing. Plans of this house are shown on page 148.

Fig. 16.—DINING-RECESS TREATMENT IN HOUSE AT JORDANS, BUCKS
Plans of this house are given on page 146.

tain shown in the closed view is the William Morris "pomegranate" tapestry in the red and buff colours.

The Dining-room

The illustration of the dining-recess shows the curtain and its oak pelmet extending to the south-east wall. The loggia is approached down two steps, and there is a fixed teak seat along the far side. In this view and that of the living-room, the flat-fronted No. 24 Rayrads will be noticed. This is a type which is less obtrusive than the usual column radiator, and is suitable where plain surfaces are required. Another detail is that the metal casement window is of the folding type without a fixed mullion; the view is thus unobstructed by the usual vertical division, the casement being closed by means of an espagnolette bolt. There are also side lights with ventilators for use in cold weather.

The Bedrooms

The bedroom photograph shows the positions of beds under small standard metal windows—an arrangement which may be thought draughty. It is found, however, that metal windows are so accurately made that no discomfort is felt. The other view is of the recessed dressing-table and the two wardrobes set flush with the wall of the room. It may be mentioned that a range of cupboards along the side of a bedroom acts as a good sound-insulator. The wardrobes contain shelves to one side and a hanging rail across the remainder. There are two folding windows along the south-east side—one of which shows in the illustration. The glazed door to the sleeping-balcony appears in the view of the house from the east.

The Staircase

The oak staircase has already been mentioned. It has a solid balustrade wall with an oak capping. The treads are screwed down on concealed strings, and a stepped skirting covers the ends of treads and risers. The staircase side of the balustrade wall is lined with oak plywood, and this lining extends around the dwarf walls of the first-floor landing.

The lighting of the hall, landing, and also of the dining-room is by means of circular metal fittings in the thickness of the floor, the glass being sandblasted and fixed flush with the ceiling.

The steps to the tank and workroom are contained in a small cupboard about 6 in. deep in the lobby to the bathroom, and can be readily opened out for use.

The Kitchen

As indicated in the view, the kitchen fittings are of painted plywood. The colour matches the pale primrose of the wall tiling. The equipment

includes twin sinks with a swivel hot- and cold-water tap, and a flat teak draining-board (with tapered grooves) which is carried round as a table top to the dresser. The water softener, electric cooker, and washing machine, and an adequate boiler to supply hot water and radiators, are conveniently placed around the room.

The floor near the boiler is of grey quarry tiles, and the remainder of thick grey linoleum stuck down to the cement subfloor.

Lavatory and Bathroom

The lavatory also is floored with grey linoleum, and the bathroom and w.c. with cork tiles, with a coved skirting of the same material. Cream tiling with a blue capping at door-head height is carried round the bathroom walls, and the fittings are placed as shown on the plan.

THE GARDEN

The layout plan shows how it is intended to relate the house and garden.

One approaches the stone terrace through the loggia, and stepping-stones lead across the lawn. A wide bed backed by flowering trees and shrubs extends down the south-east side, and a narrower bed of shrubs borders the garden to the north-west. The flower bed across the garden beyond the lawn is curved on plan with a view to giving it a more level contour than if it crossed the garden in a straight line. Fruit trees are planted at the back of this bed, and with the help of berberis shrubs placed between them will tend to obscure the vegetable garden from view. At the foot of the terrace wall is a rose bed, and immediately around the house are narrow flower plots for the smaller plants, which should provide a pleasant contrast to the buff colour of the walls.

CONCLUSION

This description of the designing and carrying out of a small modern house may serve to focus the reader's attention upon the significant aspects of domestic architecture.

The chief aim should be the creation of a setting which will make possible a pleasant life for the family. The main factors should therefore be cheerfulness and restfulness, convenience, and enough seclusion to enable the family to live its own life private and social as freely as modern conditions make possible. The designer must always base his art on such human needs as these.

Further considerations are the importance of every building showing a pleasant exterior to all who may see it, and expressing a certain neighbourliness towards other buildings in its vicinity.

SWIMMING POOLS

NOTES ON PLANNING AND DESIGN

SWIMMING pools may be classified into five categories as follows, though intermediate or combined types are to be found.

(1) Learners' Pools.
(2) Swimming Stadia and Diving Pools.
(3) Road-house Pools.
(4) Corporation Baths.
(5) Pleasure Pools.

The dimensions given below are basic and may be added to or slightly rearranged as the site demands.

Learners' Pools

The owner of a large house may build a small open-air pool to encourage his children to swim. A school may build a similar but larger and more elaborate pool. In fixing the dimensions the following figures may be useful. An expert swimmer, however tall, can swim in 2 ft. 9 in. of water and can safely take a racing header off the side into 2 ft. 6 in. of water. An adult beginner requires a depth of about 4 ft. 6 in. when learning to swim or dive. Unless required for very small children (under 6 years) the depth of water may therefore vary from 2 ft. 6 in. to 4 ft. 6 in., as in Fig. 1. The small waves made by other swimmers are very troublesome to beginners. A bath which is square in plan is calmer than a long, narrow one of equal area, and a short, wide pool is therefore better for learners than a long, narrow one.

A bath 30 ft. by 30 ft. in plan is about the minimum size, as anything smaller is scarcely any use, even for kiddies.

Swimming Stadia and Diving Pools

A swimming stadium for national and international contests should be 55 yards long for races of 220, 440, 880, and 1,760 yards. A removable timber staging or bridge will cut the length down to 50 yards for races of 100, 150, or 200 yards, while a removable timber nose will give a length of 50 metres for races of 100, 400, and 1,500 metres. The depth should everywhere be not less than 8 ft.

This bath is used for three different purposes : swimming, water polo, and plunging. A first-class swimmer complains of " bottom drag " if the water is less than 5 or 6 ft. deep. First-class polo requires an

Fig. 1.—LEARNERS' POOL

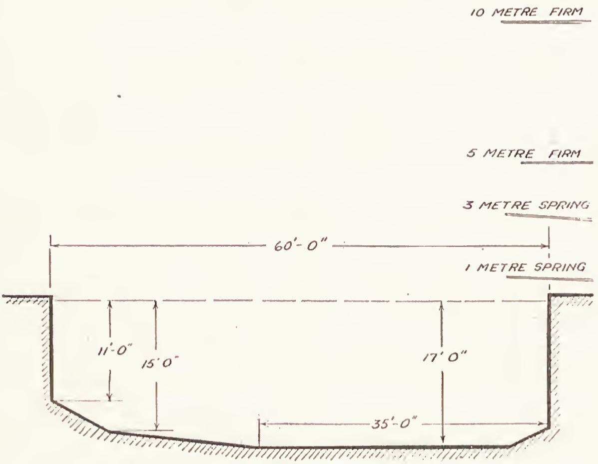


Fig. 2.—DIVING POOL

area of 90 ft. by 60 ft., of such a depth that the players cannot stand, while a first-class plunger may reach a depth of 6 ft. at the bottom of his dive and may run over 90 ft. horizontally. A depth of 8 ft. also keeps beginners out of the pool and leaves it free for experts to train in.

The width of the bath should be such as to accommodate eight swimmers in roped-off lanes. A swimmer can, with some discomfort, swim in a lane 7 ft. 6 in. wide, but a width of 9 ft. should be allowed for the inside lanes and 10 ft. for the outside lanes, where the swimmers get the back-wash from the side walls. Six lanes at 9 ft. and two at 10 ft. give an over-all width of 74 ft.

The dimensions of the pool will therefore be 165 ft. long by 74 ft. wide, with a uniform depth of 8 ft.

In first-class competitive diving, the performer (except in running dives) springs vertically into the air, performs a series of complicated acrobatic movements, and falls vertically end-first into the water. The dive is not completed until the whole of the body is below the surface, and the diver cannot start to flatten out until he is sure that the highest part of his body is below the surface. By this time the lowest part of his body will be 8 ft. or 9 ft. down. The dives are performed from firm boards at 5 and 10 metres (32 ft. $9\frac{3}{4}$ in.) above water-level, or from spring-boards at 1 and 3 metres.

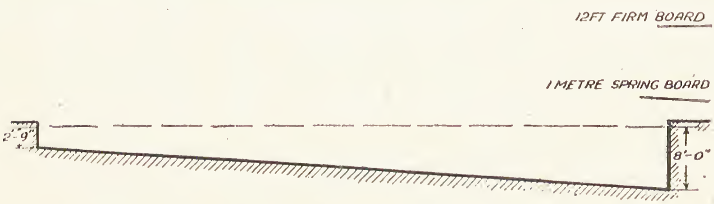


Fig. 3.—ROAD-HOUSE POOL

A diver cannot properly use even a 1-metre

spring-board unless the water is 10 or 12 ft. deep, while a dive from the 10-metre board needs a depth of 15 or 16 ft. In order to give room for a vigorous running dive off the 10-metre board the pool should have a length of about 60 ft. The minimum diving equipment of one fixed board at 5 and one at 10 metres, with one spring-board at 3 metres and one at 1 metre, needs a width of 45 ft. If, as is usual, there are two spring-boards at 3 metres and two at 1 metre, the width should be 60 ft. A section of a diving pool is given in Fig. 2.

Some designers, either from lack of funds or from ignorance, combine the 165-ft.-long swimming stadium with the diving pool, which means that it cannot possibly be used as a training pool for swimmers and divers at the same time.

Road-house Pools

These open-air pools do not cater for the expert. The depth usually varies from 2 ft. 6 in. to 8 ft. A pool 40 ft. wide by 60 ft. long is suitable for a small establishment, or 50 ft. wide by 100 ft. long for a larger one. Many existing road-house pools are too narrow, and a width of 30 ft. is the minimum desirable. They are usually equipped with a 1-metre spring-board and a firm board 10 ft. or 12 ft. above the water.

The reader who refers to the previous paragraph on diving pools may wonder how a 12-ft. diving stage can be safe with only 8 ft. of water. The truth is that an expert diver, in order to avoid damage to his person by diving into such shallow water, is forced to turn his " dive " into a sort of semi-plunge. The inexpert perform with such indifferent skill that there is no likelihood of their striking the bottom. Fig. 3 shows a longitudinal section.

Corporation Baths

These are generally covered in. They are expected to serve as learners' pools for schoolchildren and adults, as the headquarters and training quarters of the local swimming and diving clubs, and during hot weather have to cope with an inrush of non-swimmers. In addition, they have to house and provide seating accommodation for all local swimming galas. The ideal bath would have a large learners' pool, a full-size pool 165 ft. by 74 ft. by 8 ft. deep, and a diving pool (as Fig. 2), but the provision of all these three pools under one roof appears at present to be merely a Utopian dream.

As a rule, neither space nor funds will allow of separate pools, and some kind of unsatisfactory composite pool is always built. This is not quite true, as usually there is a " First-Class Bath " and a " Second-Class Bath," but each of these baths has to function as a separate establishment.

Fig. 4 shows a size of pool which is often found as a second-class bath. It is fit for only third-rate local club races (in which it will accommodate

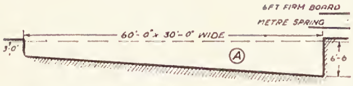


Fig. 4.—Second-class bath

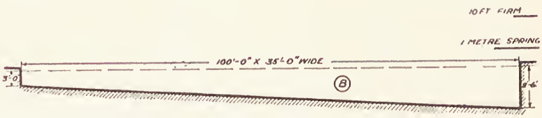


Fig. 5.—Pool for second-class club races and polo

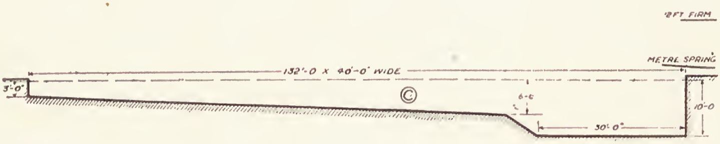


Fig. 6.—For first-class club races and polo and deep enough for full use of 1-metre spring-board

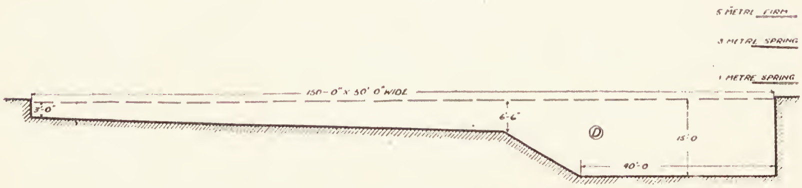


Fig. 7.—Pool for local championship races and polo

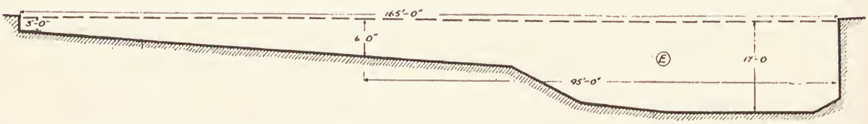


Fig. 8.—Pool for district championship races and polo and deep enough for all diving contests

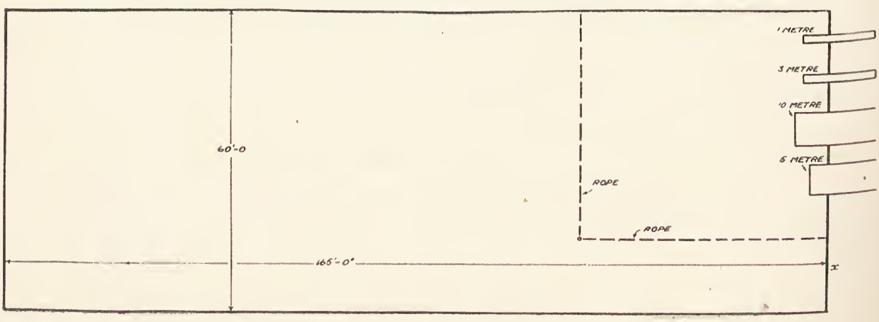


Fig. 9.—Plan of the bath in Fig. 8

five or six swimmers abreast) and third-rate polo, and is of no use for any serious diving.

Fig. 5 shows a pool fit for second-class club races and second-class polo, but not really fit for any diving.

Fig. 6 shows a pool fit for first-class club races and polo and deep enough for full use of the 1-metre spring-board.

Fig. 7 shows a pool fit for local championship races and polo. It is also deep enough for all spring-board diving contests and for full use of the 5-metre firm board.

Fig. 8 shows a pool fit for district championship races and polo and deep enough for all diving contests. Fig. 9 is a plan of this pool. By roping off the area in front of the diving boards, serious swimmers may swim, and plungers take off from x while divers are practising.

In labelling these pools as fit for first-, second-, or third-class swimming, the writer is well aware that many important contests in the past have been held in small baths, but the case for building bigger and better baths is becoming increasingly realised.

Pleasure Pools

These are similar to road-house pools, and may be provided with artificial waves and other attractions, such as loud-speakers, a dancing floor, sun lounge, restaurant, and cock-tail bar.

FACILITIES TO BE PROVIDED

The swimmer wants a clean, comfortable dressing-box with clean, safe storage for his clothes, a good tepid shower, a pool full of clean, pure water so arranged that he cannot slip, cannot hurt his toes when taking off, and cannot collide with any unexpected projections. The club official wants a bath of an exact standard length, divided up by ropes, marked out in lanes, set out for polo, and with room to walk round the edge when starting, judging, or timing races. A proper layout and proper arrangement of the details will do much towards achieving all these.

Learners' Pools

A small private pool does not really need any of the elaborate arrangements necessary in large public pools. A plain concrete or reinforced-concrete bath, with a 1-in. or 2-in. inlet pipe, a 2-in. or 3-in. outlet pipe with a stop-valve, and an overflow opening as in Fig. 10, comprise all the necessities. The coping of the bath should be about 15 in. wide and non-slippery.

If funds permit, the appearance of the bath may be improved by using coloured cement for the top of the coping, and painting the walls and bottom with a cement paint such as "Cementone."

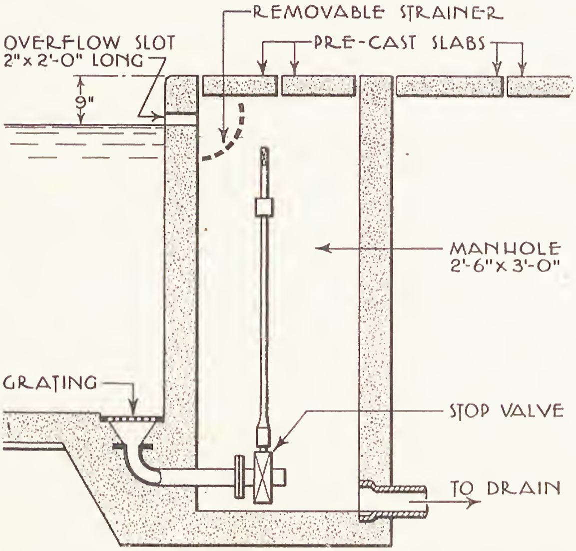


Fig. 10.—OVERFLOW AND OUTLET FOR SMALL PRIVATE POOL

Swimming Stadia and Diving Pools

The comments referring to corporation baths will apply to these.

Road-house Pools

These seldom get so crowded as corporation baths. Open-air pools are less liable to develop nuisances than closed-in pools. In pools of this type, a properly designed cascade water inlet can provide an attractive feature. If the bath will never be used for racing or polo, the exact length of the pool is unimportant, and the racing-lines and polo marks are not required.

A small pool should have a scum channel along one end, and larger pools should have scum channels all round. The minimum width of surround, size of dressing-box, etc., should be as for corporation baths.

Corporation Baths

It is possible to make alterations to the diving platforms, polo goals, dressing-boxes, or similar gear at any time, but it is practically impossible to alter the walls of the pool once they are built, and very difficult to alter the permanent pipes and drains.

All walls must have a continuous scum channel. This keeps the surface of the water clean. Many swimmers, particularly beginners, have to spit when in the water. The scum channel serves as a handy spitoon and saves much objectionable contamination of the water. No hand-railing, other than the edge of the scum channel, is necessary or desirable. The surface of the walls must be non-slippery, the coping must not project, must be level and non-slippery, and have a slightly rounded edge. The best depth from top of coping to lip of scum channel is about 12 in. Allowing for the small waves on the surface, the average water level will then be about 15 in. down. In any case the lip of the scum channel must never be more than 18 in. below the coping.

Fig. 11 shows an arrangement of the bath wall where every detail is correct, while Fig. 12 shows an arrangement where every detail is wrong.

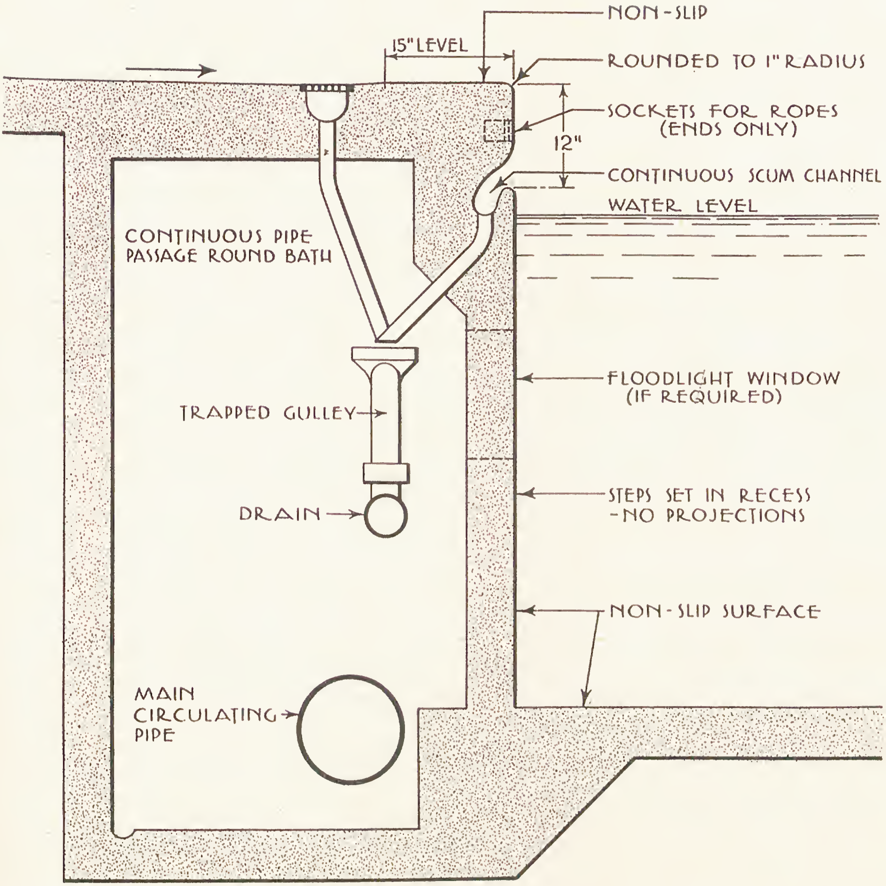


Fig. 11.—Correct details for bath wall

Permanent coloured tiles should be let into the walls of the pool to mark the centre, goal, 2-yd., and 4-yd. lines of the water-polo field, with sockets for floating ropes to mark the goal-lines.

Ladders

The ladders should be let into recesses in the walls, and not allowed to project into the waterway. The best surface for the wall is glazed tiling, but if this is too expensive, dense concrete will do. Whatever length the bath is intended, it must be made exactly to this length. Both ends must be set out very carefully and exactly parallel, so that the length of the bath is everywhere within ½ in. of its nominal length. If the bath purports to be 132 ft. long it must not be longer than 132 ft. 0½ in. nor shorter than 131 ft. 11½ in.

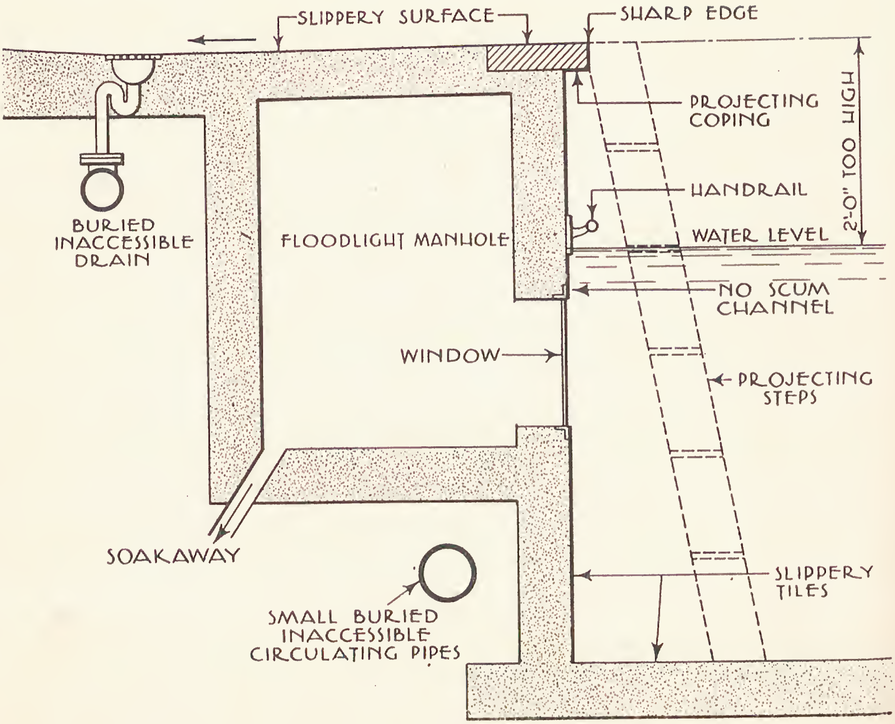


Fig. 12.—INCORRECT DETAILS FOR BATH WALL

The Bottom Surface

The cleanest surface for the bath bottom is glazed tiling, but if this is too expensive dense trowelled concrete will do. Some tiles are rather slippery, particularly in sea water, and these should be avoided. The bottom must be marked out with racing stripes in some sharply contrasting colour. These stripes may be 6 in. wide where the water is 10 ft. deep or less, and 12 in. wide where the water is deeper. They should continue the whole length of the bath and up the wall at the deep end to within 4 ft. of the scum channel. The idea is that each swimmer in a race should swim exactly over one line.

In a full-sized swimming stadium this is easy, as there are eight "lanes," and there will be one stripe under the centre of each lane.

Any bath over 50 ft. wide should be divided into eight lanes by floating ropes, and the same principles will apply.

In a small bath with no floating ropes, five stripes may be provided in a bath 30 ft. wide ; six stripes in a bath 35 ft. wide ; seven stripes in a bath 40 ft. wide, and eight in a bath 45 ft. wide. Cross-stripes for the use of plungers should be provided at distances of 40 ft. (the R.L.S.S.

standard), 60 ft. (the A.S.A. standard), and 80 ft. from the deep-end wall of the bath.

Walking Ways

The walking way round the bath should be at least 4 ft. wide along the sides (preferably 5 ft.), and at least 6 ft. wide along the shallow end. At the deep end it should be 10 ft. to 20 ft., according to the diving platforms provided and the space they occupy.

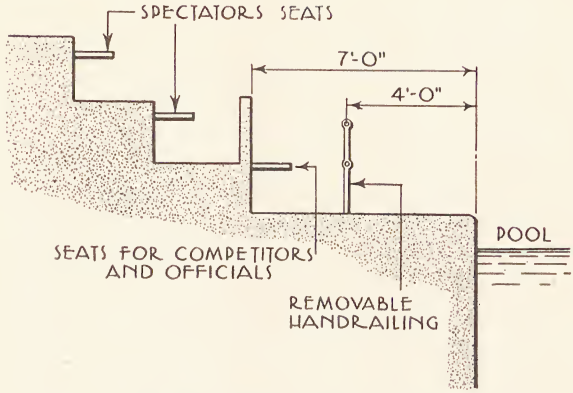


Fig. 13.—Section through side of large pool

A proposed section through the side of a bath is shown in Fig. 13.

Seating Capacity

This last figure raises the vexed question of seating capacity. Most of the small baths in London will hold about 400 spectators, and the large baths about 800. The largest attendance at the 1936 National Championships at Wembley was about 5,000. A full-sized swimming stadium for international events, or a large seaside pool, might expect 5,000 spectators, but it seems that even a large covered-in town bath of the 50-yd. or 55-yd. type will never need more than 1,000 to 1,500 seats.

It often happens that the over-all size of the site is limited, and the designer may choose between a small bath with a lot of seating accommodation or a larger bath with very few seats. Of these alternatives the second is always the better.

In the past the A.S.A. (which controls all swimming) has had to sanction important contests in very small baths, as they had no choice. So many baths are now being built that in a few years the A.S.A. will undoubtedly refuse to allow even local championships in small baths, and a small bath with many seats will therefore never stage a contest important enough to fill these seats.

Dressing-boxes

Dressing-boxes should be at least 3 ft. wide, and about 4 ft. deep front to back. All boxes must have coat-hooks, and a seat wide enough to hold a clothes-basket if this system is used.

Frequent collisions occur if anyone attempts serious swimming practice in a bath where there is more than one bather per 100 sq. ft. of water surface. With one bather per 50 sq. ft. of water surface the water is

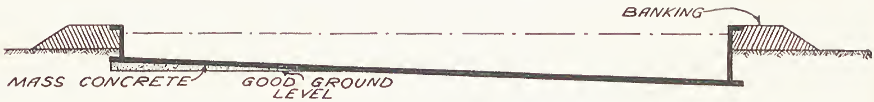


Fig. 14.—SITE OF LEARNERS' POOL WITH ONE-QUARTER MASS CONCRETE FILLING

uncomfortably full. With one bather per 25 sq. ft. of water surface swimming of any kind is out of the question.

For the sake of hygiene it must be made absolutely impossible in any new bath for any spectator or swimmer to walk along the bath side in his outdoor shoes. It must also be made absolutely impossible for any swimmer to reach the water without first passing through a disinfectant foot-bath and a heavy tepid shower. Ample lavatory accommodation is essential, particularly for a bath used by school children, many of whom foul the water if (as usually happens) their teachers are slack in this respect.

STRUCTURAL DESIGN

Reinforced concrete is in most cases cheaper and more convenient than brick or mass concrete, and only reinforced concrete will be discussed here.

Learners' Pools

The bottom of the pool must be supported on fairly good ground. The top soil must be removed and the site excavated until such ground is reached. If mass concrete costs three times as much per cubic yard as excavation then it will pay to fix the level of the pool so that one-quarter of the site has mass concrete filling, as in Fig. 14.

A design for the walls and floor, assuming that the depth of water does not exceed 4 ft. 9 in., is shown in Fig. 15. A bath with a plain concrete coping and grass surround is shown in the left-hand side of the figure. The right-hand detail shows a coloured coping and concrete surround. If the surround rests on made-up ground it is sure to sink, and precast slabs (which can be picked up and re-levelled) are much better than a continuous cast-in-situ slab.

Swimming Stadia and Diving Pools

In general structural design these are similar to corporation baths.

Road-house Pools

These will vary between the simple learners' pool in Fig 14, and the structure of the corporation baths in Figs. 16, 17, 18, and 19.

Corporation Baths

Usually built on a restricted and valuable site, the question of the space necessary to house the filters, pumps, dressing-boxes, lavatories,

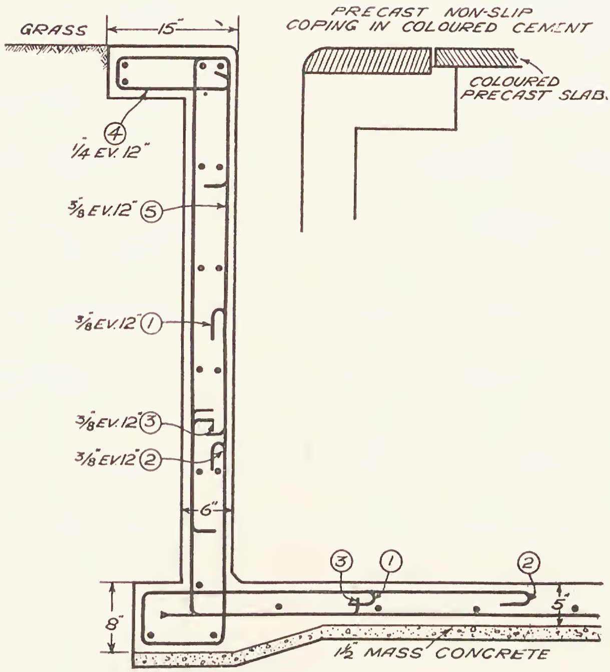


Fig. 15.—Design for walls and floor, assuming depth does not exceed 4 ft. 9 in.

Note—all steel to have 1-in. cover.

stores, etc., is often a difficult one. The old scheme of baths, where the surround was at pavement level with dressing-boxes at bath level and a small spectators' gallery, is inherently dirty, and leads to much unnecessary contamination of the bath. It is more pleasant, also, if the dressing-boxes are separated from the actual bath hall and away from its damp atmosphere. Much valuable space can be created by raising the level of the bath and utilising the space below bath level. A small pool may indeed be built entirely on an upper floor, but this is scarcely possible with deep modern pools, and only the shallow end can as a rule be kept above original ground level.

The best level for the bath is not easy to find, and the designer will probably have to try two or three different schemes before arriving at the best solution. Fig. 16 shows the shallow end of a large pool where three-quarters of the bottom slab rests directly on good ground.

Fig. 17 shows a similar pool, but constructed about 4 ft. higher, the bottom slab resting on sleeper walls of reinforced concrete. It is sometimes necessary to lift the pool in this manner to give height to basements surrounding the pool, or to keep the deep end of the pool above ground-water level. Fig. 18 is a similar pool, but raised another 7 ft., so that the space underneath the pool can be utilised for filtration plant, pumps, etc. The dimension D may be varied to suit the requirements of the particular plant installed. The best spacing of the walls and columns in Figs. 17 and 18 will depend on site conditions, and the designer will probably have to try two or three different spacings.

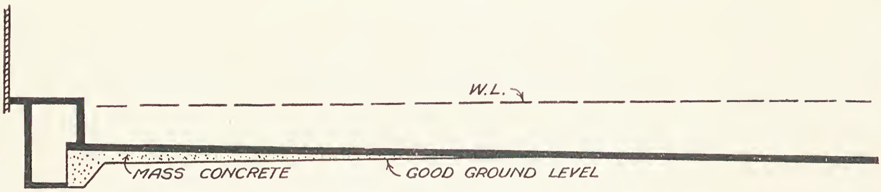


Fig. 16.—CORPORATION POOL

Shallow end of large pool where three-quarters of bottom slab rests directly on good ground.

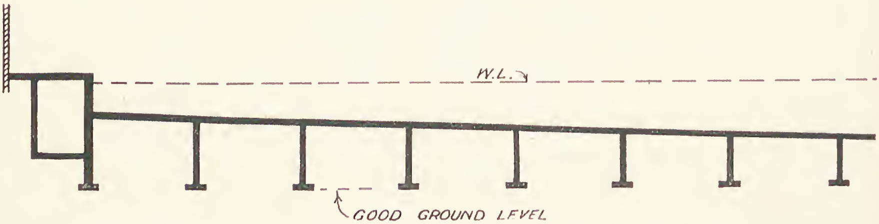


Fig. 17.—BOTTOM SLAB RESTING ON SLEEPER WALLS OF REINFORCED CONCRETE

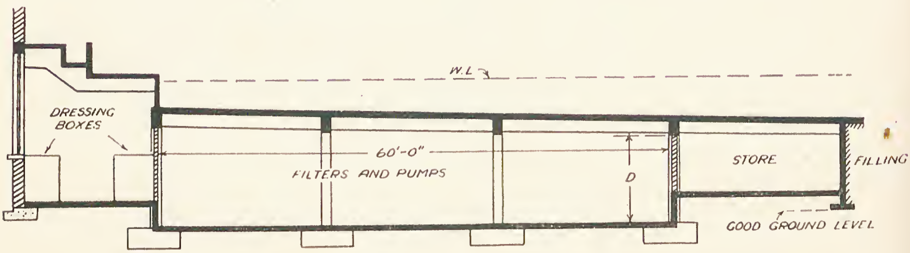


Fig. 18.—POOL WITH SPACE UNDERNEATH FOR FILTERS AND PUMPS

Dimension D to suit requirements of plant installed.

Walls

The walls of the bath are best designed as slab cantilevers. If possible, the bath should be filled with water and tested before any earth is filled back round the walls. A 6-in. wall is strong enough if the depth of water does not exceed 6 ft. 6 in., but below this the wall will have to be thickened out. Fig. 19 shows the wall to the deep end of a modern bath.

It often appears feasible, at first sight, to find some lateral support for the walls on the walking way round the bath or on the floor of the pipe gallery, but when the building is fully detailed these are so cut up by pipe trenches, changes of level, drainage channels, sumps, manholes, pavement lights, etc., that they have little real strength. There is always the added danger that the slab surrounding the pool may be cut away during future alterations, causing the bath wall to collapse outwards.

As an alternative to glazed tiling the bath walls may be faced with polished precast slabs of "Cullamix" or similar coloured concrete.

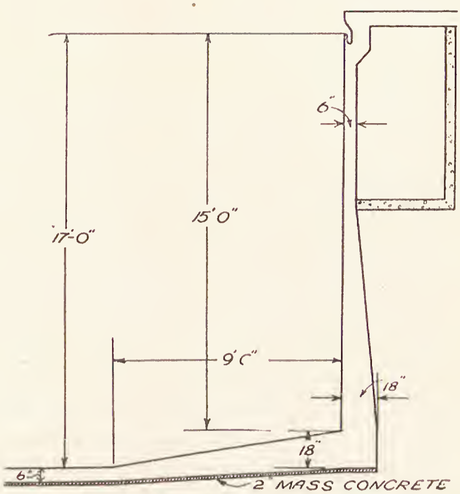


Fig. 19.—Reinforced-concrete wall to deep end of modern bath

SWIMMING BATH EQUIPMENT

In preparing plans for the layout of bathing establishments some knowledge of the necessary engineering equipment is required in order to allocate adequate housing space.

The old method of operating baths on the fill and empty principle has given place to the more hygienic method of filling once or twice per season and subjecting the water to continuous filtration and chemical treatment.

For the open-air swimming bath the equipment consists of filters, chemical-treatment plant, circulating pumps, boilers for heating the pool water, and occasionally boilers for heating shower water. The whole sequence of the water flow, from leaving the bath at the suction pipe under the influence of a circulating pump, to its delivery again at the shallow end, is shown in Fig. 20.

Filtration Plant

The size of the filtration plant is easily determined from the capacity of the bath. For indoor baths the whole volume of water must be treated in 4 hours; in open-air baths an 8- or 10-hour turnover may be used.

Take, for example, a bath 150 ft. long by 40 ft. wide, and an average depth of 5 ft. 6 in. The total volume of water is $(150 \times 40 \times 5{\cdot}5 \times 6{\cdot}25) = 206{,}250$ gallons. With a 4-hour turnover period this is equal to treating 51,560 gal. per hour.

The filtration rate depends to some extent upon the make of filters used, but a good average figure is 200 gal. per square foot of filter bed per hour. This rate of filtration gives a total area for the filters of 257 sq. ft. It is, of course, necessary to add some margin to this figure, so that four 9-ft. 6-in. or 10-ft.-diameter filters will be required.

Filters

Filters are invariably of the totally enclosed type, and may be horizontal or vertical, and consist of mild-steel cylinders with distributing

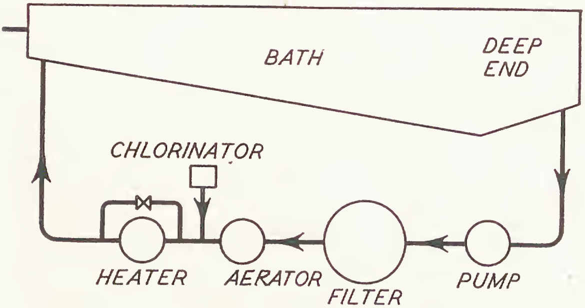


Fig. 20.—SWIMMING-BATH EQUIPMENT
Showing sequence of water flow.

pipes at the top to spread water evenly over the bed. The upper layers, to a thickness of about 4 ft., are of fine, sharp sand. One of the reasons for even distribution of water, and not increasing the rate of filtration above that recommended by the makers, is that excess will disturb the sand bed. Water travels downwards under pressure of the pump through pebbles of graded sizes below the sand bed to collector and outlet pipes.

In passing through the filter most of the foreign matter is removed, but there are many small impurities in the water which will pass through even the finely packed sand in the upper parts of the filter. In order to avoid this, chemicals which cause coagulation, or make the foreign matter form into clots, are injected into the suction pipe. The chemical injected is aluminium sulphate, which reacts with the alkaline content of the water and forms a gelatinous substance which is easily removed by the filters. This substance is deposited in a layer on the top of the sand bed ; the filters therefore require periodic cleaning.

Cleaning Filters

Cleaning is done by reversing the direction of water flow and running to drain. Alternatively, fresh water from mains is used. The upward flow of water which disturbs the filter bed is sometimes augmented by compressed air. Reversed flow causes the sand to lift and free all foreign matter, which is carried away to drain.

Chemical Treatment

Filtration is a cleaning process but does nothing towards sterilising the water. Sterilisation is carried out by injecting chlorine gas into a special earthenware chamber through which passes a stream of water. This water absorbs chlorine gas, and the solution is injected into the main water pipe at some point after leaving the filters.

The Ministry of Health advises that a chlorine dosage of not less than ·2 or more than ·5 part per million be used. This amount will maintain bacteriological purity, and if kept about ·4 part per million no discomfort is experienced by bathers.

Aeration

With continuous use, the same water, pure though it is, becomes flat and uninviting in appearance. This is because much of the air

Fig. 21.—THE MILE END MUNICIPAL BATHS

This establishment contains, in addition to swimming bath, Turkish, Russian, and private hot-bath facilities. A refreshment buffet is provided. The swimming bath (see Fig. 22) is 85 ft. long and 30 ft. wide, and varies in depth from 3 ft. 3 in. to 8 ft. 3 in. The pool is emptied and covered with flooring to form a public hall for use during winter months. The hall is 97 ft. long and 45 ft. wide, and contains 52 collapsible dressing-boxes. The seating accommodation is 890 persons, viz. 640 on the ground floor and 250 around the balconies. Electric lights are concealed behind glass panels and laylights, with the exception of a few small emergency lights in wall fittings. Water in the bath is illuminated by means of ten floodlights placed in watertight portholes around sides of bath about 18 in. below water surface. (*Architect : Bernard J. Belsher, F.R.I.B.A., M.Inst.C.E., M.I.Mech.E.*)

Fig. 22.—SWIMMING POOL AT MILE END MUNICIPAL BATHS

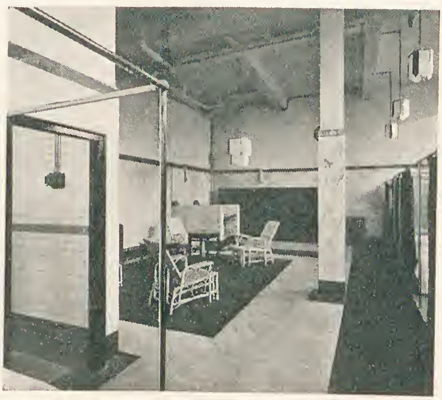


Fig. 23.—TURKISH-BATH LOUNGE AT MILE END MUNICIPAL BATHS

imprisoned in the water, and to which it owes its sparkling appearance, is drawn off. The water is therefore passed through a closed or open aerator. Closed aerators are simply closed mild-steel cylinders fed with compressed air and provided with a vent for escape of the excess air. Open aerators add much to the attractiveness of the bath, as they are simply open fountains or cascades, which may or may not be artificially illuminated. In these, of course, the bath water absorbs air from the atmosphere.

Heating

The last process before water is redelivered into the bath is heating. The general method is to install a steam *calorifère* working on low-pressure steam. Many open-air baths, on account of the disadvantage of a chimney stack, have gas or electric heating. Where the latter is used heating is carried out at night and an off-peak load used. The cooling during the day is small. Where any of the other types of fuel are used heating is only by day. Very little heat is required to maintain a bath temperature which varies between 65° and 75° F. In open-air baths the midsummer temperature rises above this level, due to sunshine. In the early and late season—more particularly April and May—the temperature drop in 12 hours rarely exceeds 5° F. when fires are shut off: with banked fires the variation is of the order of 2° F.

MUSEUMS, ART GALLERIES, AND LIBRARIES

NOTES ON DESIGN AND PLANNING

MUSEUMS, art galleries, and libraries can suitably be considered in the same category not only because they are often housed in the same building or group of buildings, but because they have a certain element in common. All three of these types of structure are repositories of things which are in themselves precious, and yet at the same time of a kind to which the general public should have access. They have yet a third quality in common, inasmuch as they all dispense, or can suitably dispense, with a certain feature which belongs to many other types of building, that is, the window in the wall. Museums, art galleries, and libraries are usually top-lit, for a very good practical reason, namely, that the exhibits or articles of treasure and public usefulness require as much wall space as may be available within the area of the plan. This special circumstance, which influences the lighting of these three types of building, provides all of them with an element of architectural character which differentiates them from other public buildings.

Past Architectural Treatment

In the first instance, as top light was desirable in the period before there had been gained the complete mastery over the means of artificial lighting and ventilation which we have to-day, the type of building under consideration was necessarily confined to ground-floor storey, or, at least, the principal rooms were only on one floor. Thus there appears to have been established a convention that museums, art galleries, and libraries were long, low buildings which must needs attain their attribute of dignity by other means than height. We find that in many instances a classic colonnade has been chosen as a symbol of the particular kind of architectural stateliness which may suitably be exemplified in this type of building.

As examples of this treatment there immediately come to mind the British Museum, the National Gallery, and the equally well-known Library of Trinity College, Cambridge, designed by Sir Christopher Wren.

The Vatican and the Louvre

Reference is now being made to the period when these three functions began to receive independent expression. There was, however, a time

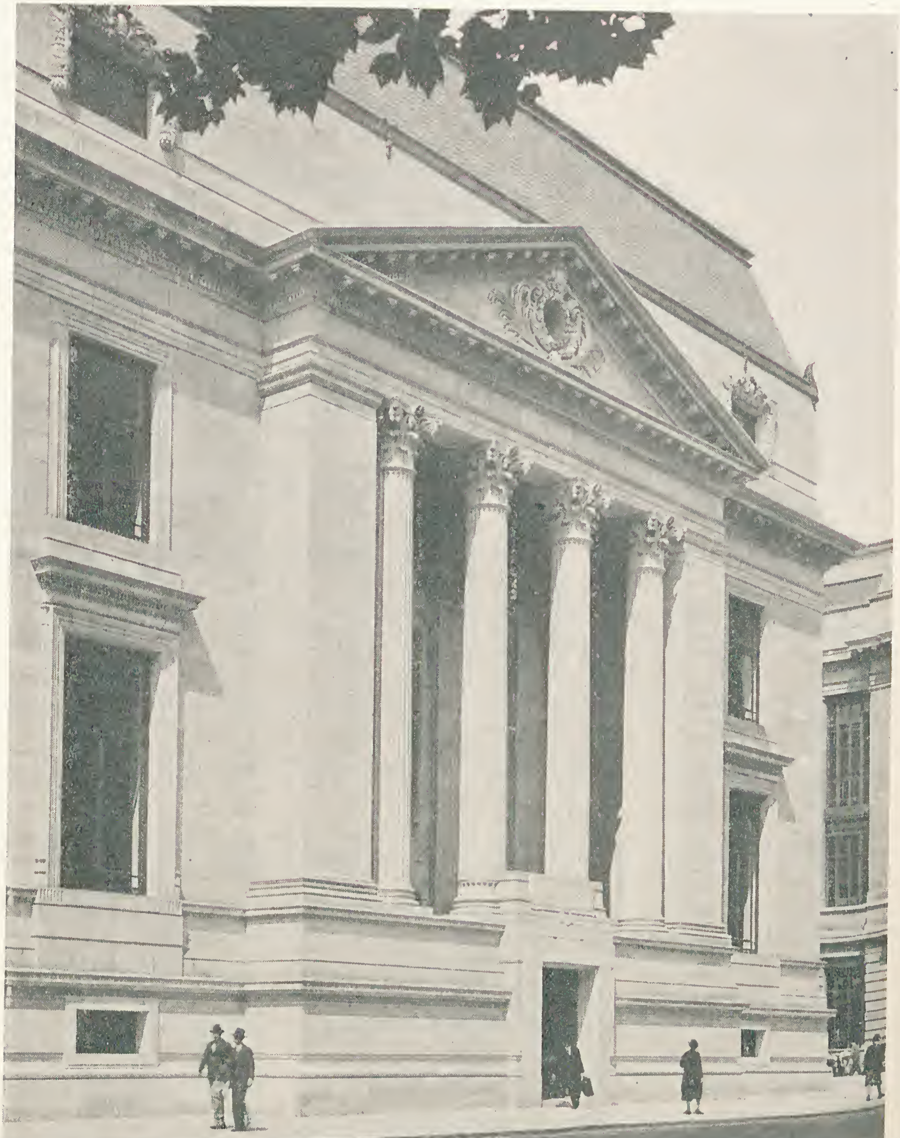


Fig. 1.—NEW GEOLOGICAL MUSEUM, SOUTH KENSINGTON, LONDON

Street frontage designed with regard to other buildings in neighbourhood, particularly the adjoining Science Museum. Corinthian order has been adopted. Long windows behind colonnade light principal staircase, and are different in level and design from the gallery windows to be seen on each side of the pedimented feature in the centre of the building. (*Architect: J. H. Markham, F.R.I.B.A. From photograph supplied by H.M. Office of Works. Published by permission of Controller, H.M. Stationery Office.*)

prior to this when the library and the art gallery were merely apartments of the palace, and as such they shared the general characteristics of palace architecture, or of the architecture of the town or country house. The Vatican and the Louvre are examples in which palaces have been used to house pictures and other objects of art. Although it is questionable whether, in the case of pictures, at least, these rooms with their side windows provide the best kind of lighting, the grand apartments of these two famous buildings have certain attributes which we must not lose sight of in the design of modern art galleries and museums. They have at least a ceremonial quality that suggests that the housing of these precious objects is an important architectural occasion, and that it is not suitable to put them between bare walls or in chambers which are merely utilitarian. A certain grandeur of expression is appropriate in public halls which are to house the great treasures of art which we have inherited from the past, and this grandeur must be present not only in the inside of the building but on the outside as well.

Exterior and Interior Decorative Treatment

Because a museum does not happen to have windows in the walls it should not for that reason be allowed to resemble a frozen-meat store. It must be decorated with symbols in some manner expressive of its social importance.

The grand columns associated with the elevations of the British Museum are not necessary to the stability of the building, but if in imagination we strip them off, it becomes immediately clear that the design has suffered a deprivation of dignity. In the interior, also, we find in this famous building the Classic Order on a great scale, highly decorated ceilings, and an employment of the full repertory of classic ornament.

This is not to say, however, that there should be no limit to the ornateness of such interiors. It is, of course, obvious that the walls should be the background for the display of the exhibits, but it is possible to strike a happy mean and ensure that the rooms are sufficiently reticent in style to perform this function of being a background, while at the same time they declare by their architectural character that they are important rooms. In the British Museum this happy mean is achieved, for the richness of the ceilings is of a type which is pleasantly satisfying without being arresting, and it supports the general idea of interest and ceremony which is here appropriate. If the ceiling had been quite plain and flat, it would in point of fact have attracted more attention to itself by the lack of intellectual content in its design than it now does by virtue of its ornament, which in no way conflicts with the objects below, whether they be statuary or other archæological exhibits.

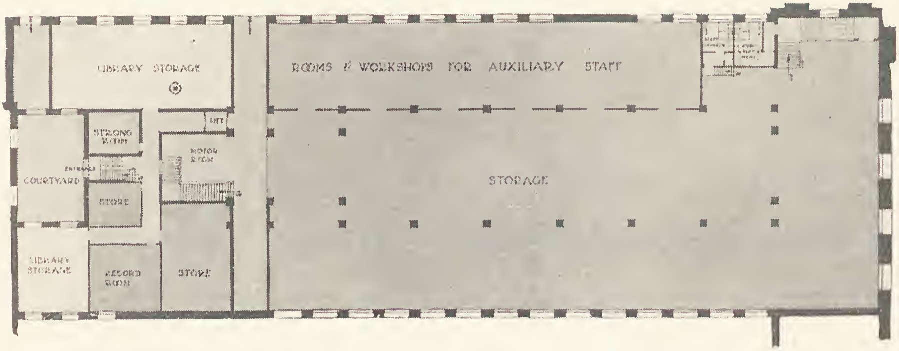


Fig. 2.—New Geological Museum, South Kensington—basement-floor plan
(From plans supplied by H.M. Office of Works. Published by permission of Controller, H.M. Stationery Office.)

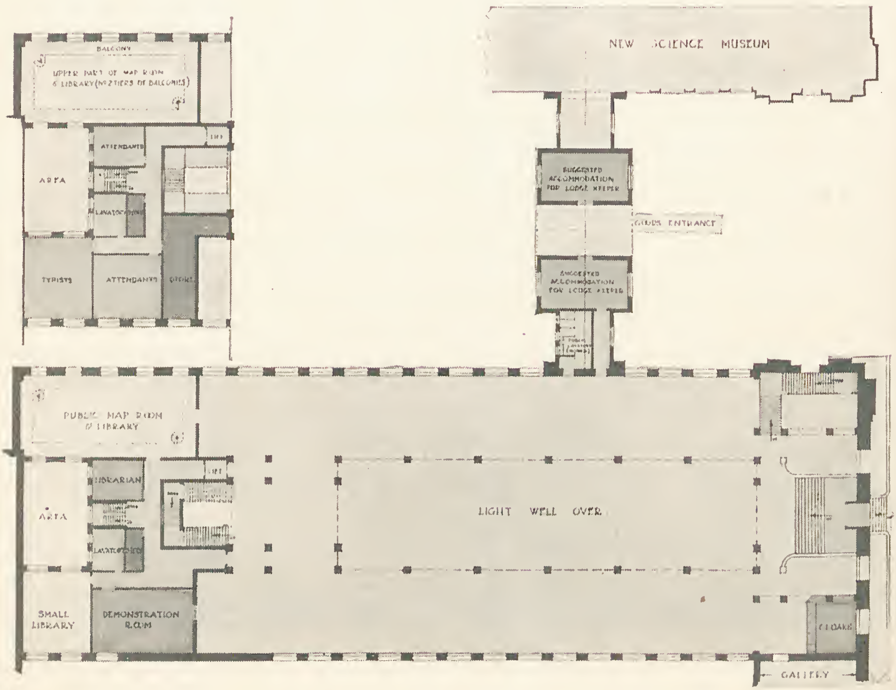


Fig. 3.—New Geological Museum, South Kensington—ground-floor plan
(From plans supplied by H.M. Office of Works. Published by permission of Controller, H.M. Stationery Office.)

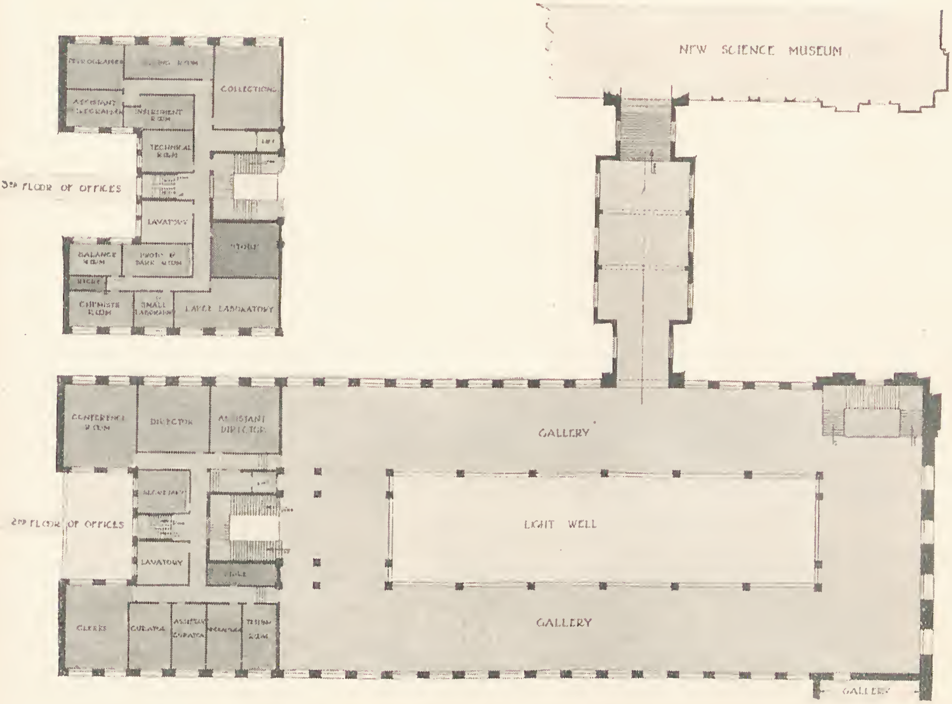


Fig. 4.—NEW GEOLOGICAL MUSEUM—FIRST-FLOOR PLAN

(*From plans supplied by H.M. Office of Works. Published by permission of Controller, H.M. Stationery Office.*)

MUSEUMS

Arrangement of Exhibits

Of the three types of building here under consideration, the museum presents the least difficulty in its planning. What is required is a series of rooms in which the exhibits can be shown, placed either against the walls or in the middle of the room in appropriate cases. Various types of exhibit will, of course, require special arrangements for their proper display. The reader will himself recollect from his own experience all the various kinds of objects which one finds in a museum—accoutrements of war, prehistoric relics of all kinds, coins, crockery, metal implements, jewellery, and, coming to a later date, there are furniture, tapestries, and a vast number of objects of a kind which can suitably be put into a glass case. No very complicated rules need be observed in the display of such objects, except the obvious one that where the things in question should be looked at from all sides if we are to appreciate their full interest and beauty, it is desirable to place them in the middle of the room so that people can walk around them. When you add that the rooms should

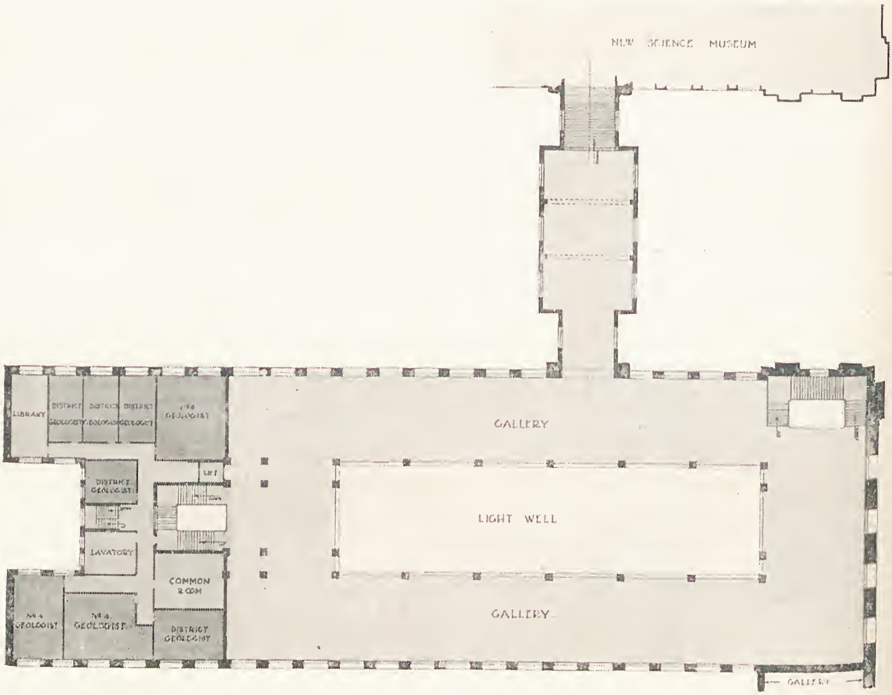


Fig. 5.—NEW GEOLOGICAL MUSEUM—SECOND-FLOOR PLAN

(*From plans supplied by H.M. Office of Works. Published by permission of Controller, H.M. Stationery Office.*)

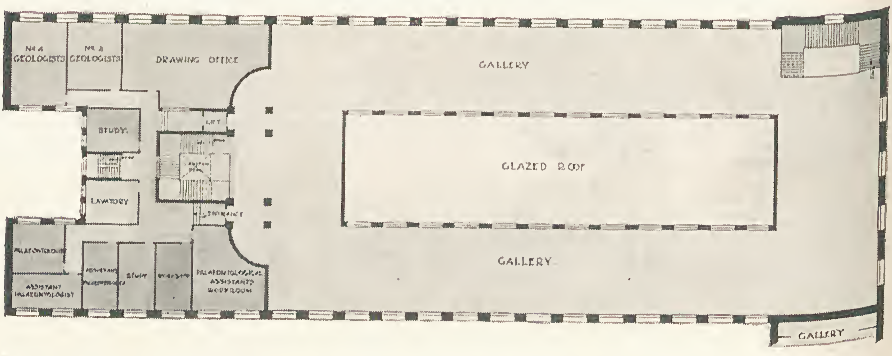


Fig. 6.—GEOLOGICAL MUSEUM—THIRD-FLOOR PLAN

(*From plans supplied by H.M. Office of Works. Published by permission of Controller, H.M. Stationery Office.*)

preferably be *en suite*, so as to allow a complete circulation, and that sufficient space should be left in each room for people to study the exhibits without impeding the flow of traffic, little more need be said.

It is of frequent occurrence that a museum houses pictures as well as other objects of interest, and this is especially the case in the smaller local museums, where there is no room for the display of pictures by themselves. In such circumstances the pictures are apt to take their chance, and are hung on the walls wherever convenient, irrespective of the fact that the lighting of such pictures is usually of the wrong kind.

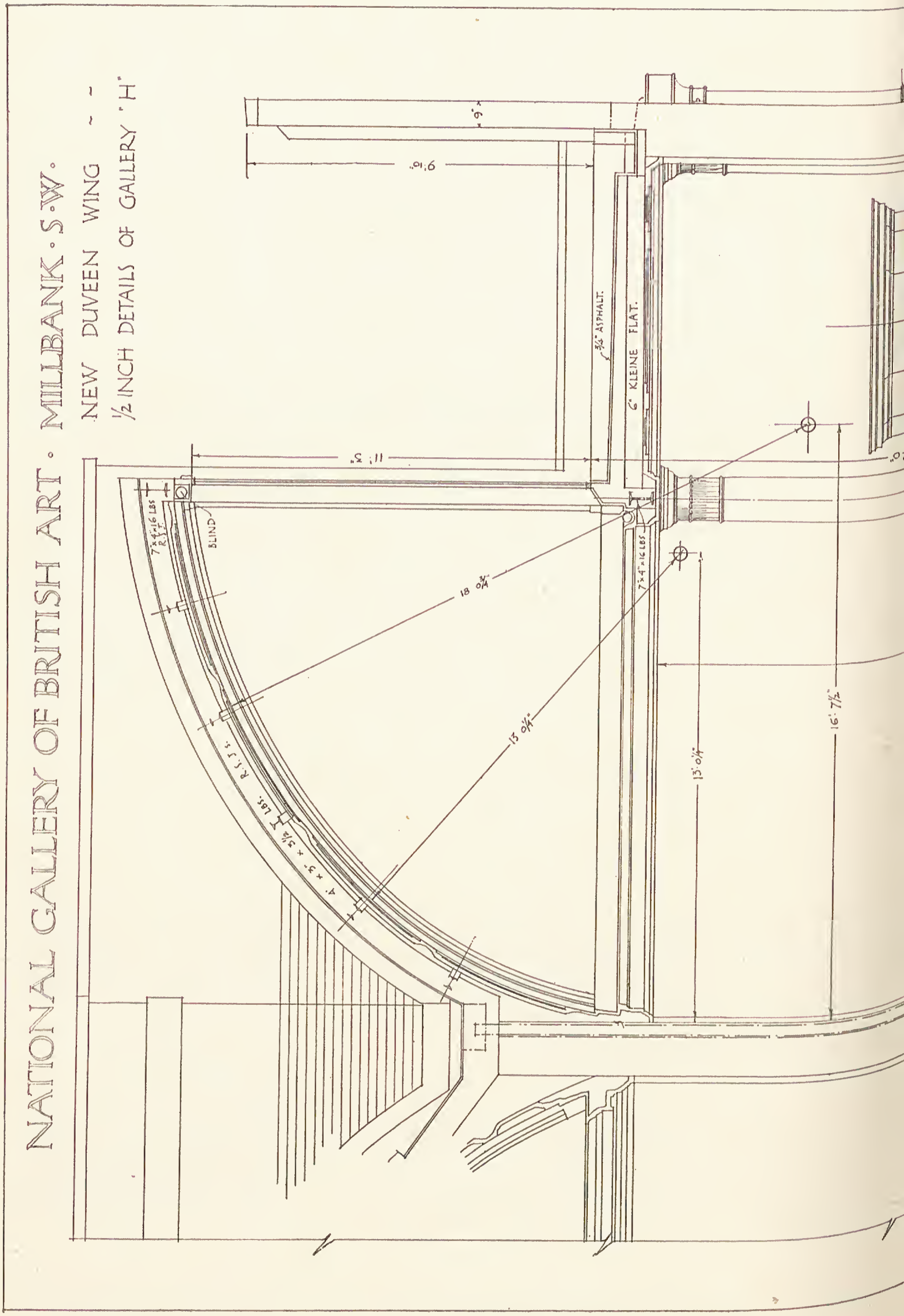
ART GALLERIES

Picture Lighting

Let us next consider the art gallery, designed for no other purpose than the display of pictures. It is only within the last thirty years that there has been a scientific study of this question of the proper lighting for pictures, and certain interesting results have been arrived at which have an important bearing upon the design of picture galleries. The commonest fault which is noticeable in the older type of gallery, built before the era of specialist knowledge of picture lighting, is that the glass of the pictures reflects the light and takes upon itself some of the characteristics of a mirror. Consequently, when looking at the picture one finds that one is looking at the reflection of oneself. It has been ascertained beyond any doubt that this irritating reflection occurs whenever the spectator is in stronger light than the picture. When architects first began to design galleries especially for pictures, they thought that they had made a great advance when they got rid of the side windows and substituted for them top lights. To their dismay, however, they discovered that the reflection was as bad as ever, for the simple reason that persons standing near the middle of the room were in just as strong, or slightly stronger, light than were the pictures hanging on the walls. In addition to the reflection of the spectator there is, of course, the reflection of other objects in the room, and especially of the source of light itself, which, whether the windows be in the walls or in the ceiling, obtrudes upon one's vision of the picture.

The Seager System of Lighting

The pioneer in this study of the scientific lighting of pictures was a New Zealander named Seager, and his investigations have been the basis of modern practice in this regard. He found that all that is needed to remove these reflections is so to arrange the lighting that the spectator is in shadow, or at least in a markedly less light than is the picture. This object can be achieved in a variety of ways. A quite common one is that which is exemplified in the new wings of the Tate Gallery, where one finds a flat ceiling above that part of the room in which the spectator


NATIONAL GALLERY OF BRITISH ART · MILLBANK · S·W·
NEW DUVEEN WING
½ INCH DETAILS OF GALLERY 'H'
6" KLEINE FLAT.
BLIND
18 0¾"
13 0¼"
13' 0¼"
16' 7½"
11' 5"
9' 10"

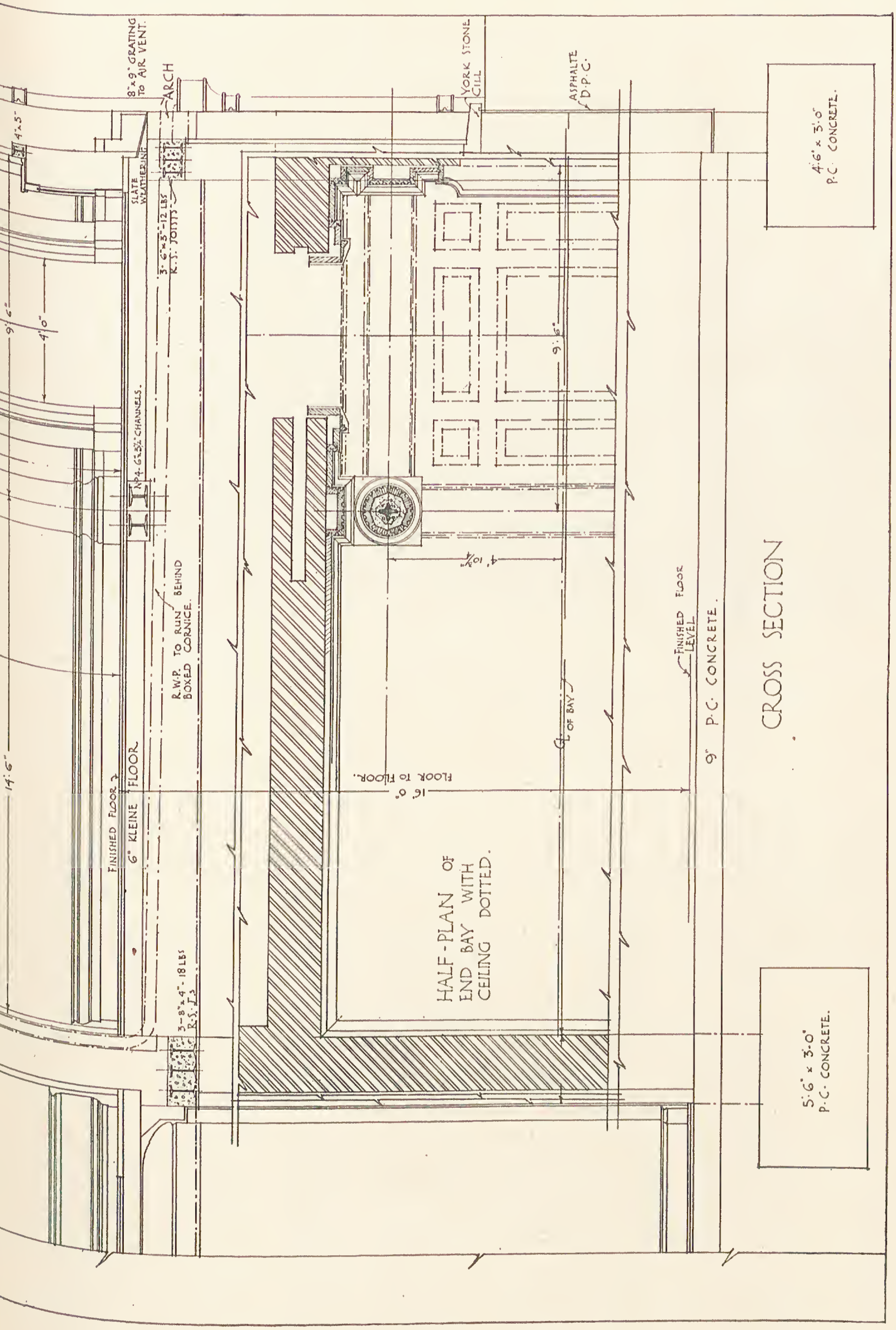


Fig. 7.—THE NEW WING OF THE TATE GALLERY, LONDON

Probably the best English example of the scientific lighting of pictures. (*Architects: Romaine Walker and Gilbert Jenkins, FF.R.I.B.A.*)

Fig. 8.—WATER-COLOUR SECTION OF GRAVES ART GALLERY—SHEFFIELD CENTRAL LIBRARY

Gallery roof-lights are planned to give side-top natural lighting, to allow maximum amount of light to the picture walls. Artificial lighting gives similar effect from concealed troughs. (*Architect : W. G. Davies, F.R.I.B.A.*)

would normally stand in order to have a proper view of the pictures, and above this flat ceiling is a number of what are called top-side lights—vertical windows which have been completely screened from the spectator yet throw a flood of light on to the picture. The result is perfect, in fact so good that one would be inclined to deny strongly that the pictures were glazed at all.

Even here, however, it was not sufficient to cast the spectator into comparative shadow ; it was necessary so to arrange to shade all the windows and the flat ceiling underneath them, in relation to the pictures, that the reflection of the window itself did not occur within the area of the picture.

Lighting by Artificial Light

In artificial light it was formerly even less possible than in the day-time to obtain a clear view of a glazed picture, for the same reason that usually either the spectator was himself in brighter light than the picture, or his view of it was disturbed by the reflection of the source of illumination itself. The problem is now solved by placing just above the top of the picture, and a very little distance from the wall on which it is hung, an electric light completely screened from the spectator. This is, of

Fig. 8A.—SHEFFIELD CENTRAL LIBRARY—THE LENDING LIBRARY

The busiest departments—lending library shown above, two reading-rooms, commercial and science and technology libraries—are placed on ground floor. Lending-room shelves 30,000 books, allowing total stock of 50,000, since 40 per cent. are always on loan. Notice that all island and projecting bookcases are movable. (*Architect : W. G. Davies, F.R.I.B.A.*)

course, a very much cheaper device than planning the gallery so that it exemplifies the section of wall and window recommended by Mr. Seager. In fact there is something to be said for the provision of picture-gallery lighting only by artificial light. The main difficulty, of course, apart from the expense, is that it would be necessary to use only artificial daylight if the colour values of the pictures were to be preserved.

Why Seager Method Is Not More Extensively Employed

It is surprising that although the scientific method of lighting pictures is well known, there are architects who continue to build picture galleries which completely ignore it. This may be explained partly by the laudable desire of the promoters of such schemes to make the buildings look very imposing both inside and outside, and undoubtedly the Seager method of planning does not lend itself so well to a noble appearance of the gallery itself. Municipal councillors, who are responsible for such buildings and have to bear the odium of any rise in the rates which results from expenditure on public works, feel it incumbent upon themselves to make it clear that the public has something very

Fig. 9.—Sheffield Central Library and Graves Art Gallery—the Sheffield Collection Room

Room to shelve 3,500 books, devoted to manuscripts and printed matter relating to Sheffield and district. Adjoining is a special collections room for deeds, charters, plans, etc. (*Architect : W. G. Davies, F.R.I.B.A.*)

grand for its money, and a scientific method of dealing with pictures might not be so acceptable as a more decorative treatment of the rooms in which they are hung. There is also a practical consideration which may be partly responsible for the omission to use the Seager method. It is undoubtedly rather extravagant of space, because it only permits of pictures being on one side of the room, whereas in the old-fashioned top-lit gallery all four walls could be utilised. Moreover, as has already been pointed out, in all but a very few instances art galleries are in the same building as a museum, and there is one curator responsible for both sections. As is well known, curators like to have freedom to re-arrange the exhibits, and normal rooms with top light or those with side windows lend themselves more easily to such treatment than does a gallery of the Seager type.

Fig. 10.—SHEFFIELD CENTRAL LIBRARY—MAIN ENTRANCE HALL

With marble wall-linings and floor. Stairway in reinforced concrete, finished in terrazzo with non-slip treads. (*Architect : W. G. Davies, F.R.I.B.A.*)

Another important consideration which militates against the universal use of scientific lighting for pictures is that land values in urban areas have become so high that it is often necessary to plan even museums and art galleries on several floors, and this arrangement naturally rules out the "top-side" lighting from anywhere in the building except the upper floor.

Display of Sculpture

A word may next be said on the subject of the display of sculpture. Here, of course, the difficulty of reflection does not arise, but in this case also modern methods of lighting have enabled the exhibits to be displayed

more satisfactorily. By artificial lighting especially, it is now possible, by carefully adjusting the source of illumination, to avoid shadows which distort or obscure the form of the statue.

LIBRARIES

The Reference Library

What are the special problems to be encountered in the design of libraries? The obvious division in the accommodation here required is the reading-room and the storage place for the books, and these two sections can themselves be subdivided. Libraries are of several kinds. The most important is the grand reference library, such as that of the British Museum, the Bodleian, and the University Library at Cambridge, The reference books are usually in two categories, namely, those on shelves accessible to the public, and those in the stack-room which can be obtained only by applying to the staff. A most attractive kind of library would be that in which all the books were thus accessible to the public, because this method has the advantage that the reader, on coming upon the particular book which he is seeking, also finds other books perhaps dealing with similar subjects, and he is at liberty to browse over the shelves and make discoveries which he could not hope to do only by studying the catalogues. Unfortunately, however, there is seldom space for more than a part, sometimes quite a small part, of the total number of volumes in a library to be displayed openly in this way, and the remainder must be housed in the stack-room.

The Stack-room

In this part of the building the books are stored with the greatest economy of space, in such a way that the attendants and officials of the library can find them as quickly as possible. The stack-room has usually been placed in the basement of the library. This method is employed in the reading-room of the British Museum, the Old Bodleian at Oxford, and in many other instances. Until quite recently there had been no attempt to make an architectural feature of the stack-room.

Reading-rooms—The Radcliffe Camera

Undoubtedly the most important chamber in any library is the reading-room itself, and it may be of interest if brief reference is made to a few of the most famous examples in order to ascertain what are the architectural characteristics especially appropriate to this type of room. It may suffice if we consider the Radcliffe Camera, which is the reading-room of the Bodleian at Oxford, and the British Museum reading-room.

In the former case the structure is not only beautiful as seen from the inside, but is given full external expression. This beautiful domed building, designed by Gibbs, is one of the masterpieces of our eighteenth-

century architecture, and is the dominant feature in the panorama of Oxford. Here the visitor ascends to the first floor of the building, where he finds a magnificent round chamber with galleries. He has a choice of reading books on this main floor or upstairs, where he finds himself very comfortably seated in a subdivision of the building, from which he is still able to see the dome, and can appreciate the scale and splendour of the edifice as a whole. To work in such environment is in itself exhilarating, because the building appears to be especially designed to confer honour upon the profession of learning.

British Museum Reading-room

Let us next consider the reading-room at the British Museum. This also is a domed room, but of a scale even larger than that of the Radcliffe Camera. In this instance, however, the room is built in the centre of the building, and is not visible from the exterior. It is extremely impressive, and probably nowhere in the world can so many books be seen at the same time. Yet the form of the structure is simple. The reader is not confused by a multiplicity of detail, for row upon row of books completely encircle the room, relieved only by a gilded wrought-iron gallery near the springing of the great dome. One serious defect is observable in the British Museum reading-room, but this may perhaps be remedied at some future date. It must be admitted that the ventilation is far from perfect, and this is probably due to the fact that the air outlets are too high. What appears to happen is that the carbonic acid gas breathed by the readers, originally warmer than the surrounding air, is also of slightly less specific gravity in consequence, and proceeds to rise ; but before it has time to reach the outlets so very high up it cools, and then its naturally superior specific gravity causes it to drop again. But whether or not this is the true explanation, there is no doubt that the room is uncomfortably stuffy.

Libraries of Rectangular Shape

Although these two examples of circular reading-rooms have been given first mention because of their extreme importance, it must be pointed out that a far larger number of libraries are of rectangular shape and exemplify the tradition of placing the bookshelves at right angles to the two longer walls of the room, so that they have the benefit of the greatest amount of light. The libraries of this type are too numerous to mention, but the reader will doubtless be able to call to mind examples within his own knowledge. The subdivisions of the room caused by these free-standing bookshelves are pleasantly intimate places of study, where usually a table and the requisites for writing are provided. To most people the word "library" conjures up a vision of this time-honoured arrangement of books, and undoubtedly its conveniences will lead it to be adopted in many instances in the future as well.

Cambridge University Library

The greatest recent innovation in library design is that exemplified at the University Library at Cambridge, designed by Sir Giles Gilbert Scott, R.A., where the stack-room has been made into the principal architectural feature as seen from the outside of the building. In this well-known example the stack-room is a colossal tower, having instead of windows long vertical slits which presumably are intended to provide ventilation rather than light. The form of the building is a complete departure from that traditionally associated with libraries, and in the opinion of some critics the tower, although it has this highly original type of ventilation, in its silhouette resembles a church tower and thus does not suggest to the spectator its true function. Yet undoubtedly it has a practical convenience to store the books by this method.

Public Libraries

In recent years the commonest kind of library building is not the great reference library, but the public library, of which an important apartment is that devoted to newspapers and magazines. Here also we usually find a lending library, with its appropriate organisation. In this case special arrangement has to be made in the planning to provide for effective supervision, so that nobody can leave the building with a book without the knowledge of the staff. For the purpose of the lending library it has been found desirable to make a departure from the conventional arrangement of parallel shelves standing free at right angles to the external walls, for a more convenient layout of the shelves is to make them radiate from a common centre from which the supervisor can see everybody who is making use of the library. The various systems of cataloguing books form a special study in themselves, and in the present context one can do no more than make passing reference to them. Suffice it to say that the various catalogues or card indexes for books should be situated in a convenient place for members of the public to have access to them.

Auxiliary Accommodation

In the three types of building here described, in addition to the apartments which fulfil the main purposes of a museum, an art gallery, or a library, accommodation must be found for the curator or the librarian and other officials and staff. It is nowadays customary to have workshops with modern equipment for the cleaning or repair of the exhibits which can be handled only by experts. In a very large museum, such as that at South Kensington, we find rooms for private study and a restaurant. A small flat for a resident caretaker is usually considered necessary. There has already been reference to the stack-room of a library, where there should be room for the number of books to be increased. In a museum or art gallery, also, ample space for storage is needed.

BANKS AND OFFICE BUILDINGS

Fig. 1.—SOUTH AFRICA HOUSE, TRAFALGAR SQUARE, LONDON

The level of the main order of the portico is as near as possible to that of the National Gallery, and its cornice, also, is level with that of St. Martin's Church. The portico is an adjunct to the High Commissioner's office on the first floor. The smaller portico in the attic forms a characteristic South African stoep to the rooms of the visiting ministers. (*Architects : Sir Herbert Baker, R.A., F.R.I.B.A., and A. T. Scott, F.R.I.B.A.*)

OFFICE buildings may be divided into three main types :—

(1) Offices which are designed and planned for the use of a specific tenant, whose requirements with regard to plan, mechanical equipment, etc., are more or less defined before the plans are considered. This type allows of relatively direct and definite planning. The group may again be subdivided according to the requirements of the tenant. It may be desirable to spend money on expensive finishings, materials, extravagant planning, etc., giving an opulent character to the building, which in many cases is considered sound advertising, creating confidence in the minds of all connected with the firm ; on the other hand, the building may be considered solely in terms of efficiency of service, and little consideration be given to any other aspects.

Fig. 2.—SOUTH AFRICA HOUSE—ENTRANCE HALL
(*Architects: Sir Herbert Baker, R.A., F.R.I.B.A., and A. T. Scott, F.R.I.B.A.*)

(2) Offices which are built more or less as a speculation, and on completion put on the open market for purposes of letting. In this case it is, of course, not possible to make provision for all the different types of tenant who may use the building. General principles of planning, as

described later, may, however, still be followed, though a larger financial margin is necessary to cope with alterations and variations which are certain to occur according to the specific requirements of tenants.

(3) The third type is a combination of the above types. In this case the major portion of the building is designed and planned for the specific use of one tenant, the remaining portions being sublet. The plan in this instance is usually dictated by the requirements of the principal tenant.

It is essential—and particularly so in type 2—that the revenue from net lettable floor space be related to the cost of the building. This may appear obvious, as in point of fact this must be so in any building of a commercial character. It is, however, relatively easy to demonstrate in the case of an office building.

Allowing an average floor-to-floor height of 11 ft., a useful rule of thumb or empirical formula is :—

$$\frac{\text{rent per square foot lettable floor area}}{\text{cost of 15 cu. ft.}} = \text{gross return.}$$

Example.—Rental 7*s.* 6*d.* a foot super.
Building cost 1*s.* 8*d.* a foot cube.

$$\frac{7s.\ 6d.}{1s.\ 8d. \times 15} = \text{gross return, i.e. 30 per cent.}$$

Preliminary Planning Principles

As in other buildings, all restrictions due to adjoining owners' rights, ancient lights, party walls, town-planning requirements, local building regulations, etc., must first be ascertained. In a great many buildings the ground floor is considered first when planning. This is not so in the case of office buildings. The typical office floor is the most important, being the principal source of revenue. If for any reason some sacrifice in plan must be made it is much better to make it on the ground floor rather than to allow any restriction in plan being repeated on every floor right up the building. The more floors there are the more essential it is that the typical office floor must be as near perfection as possible with regard to plan.

The plan should be conceived to avoid interior light wells altogether, if possible ; if this cannot be achieved, then sacrifices may be necessary to make the well as large as possible. It is better to have a smaller lettable floor area well lit and all usable, rather than have large areas of space inadequately lit, and virtually blind spots, in the plan.

Flexibility of planning is in all cases desirable, but particularly so in type 2, where exact details as to the requirements of individual tenants are not known. The plan should permit of large or small areas being let without detriment to the amenities of the tenant. In general it will be found desirable to have a large number of comparatively small units, as this will facilitate the letting. In other words, the market for relatively

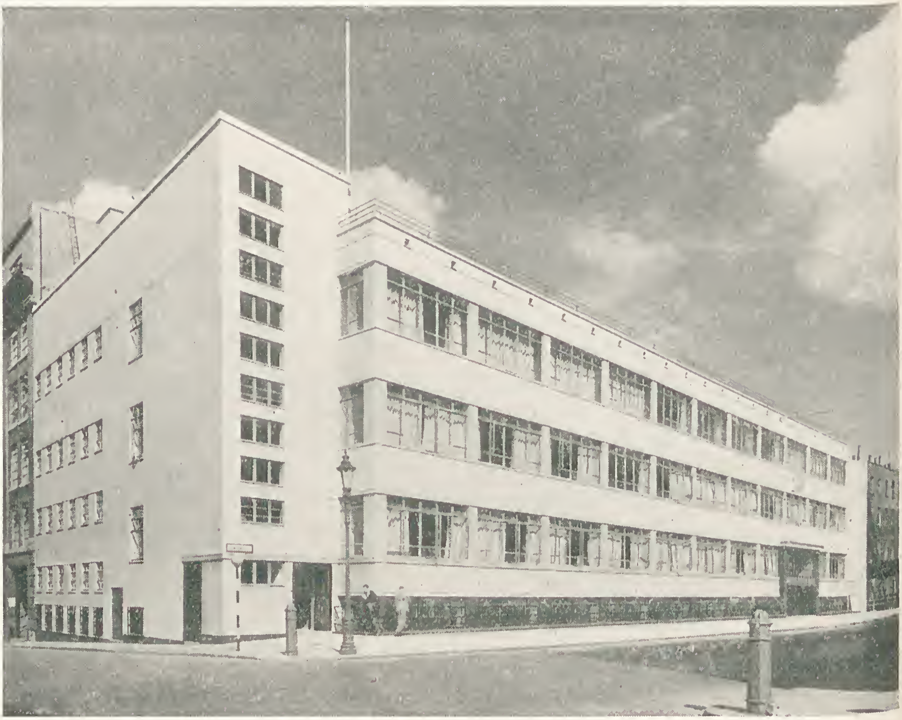


Fig. 3.—Boots Pure Drug Company's offices, Stamford Street, London

The accommodation includes board room, offices for directors, general offices, canteen and recreation rooms for the staff, and a conference room, which can be used for cinema lectures for staff instructional purposes, with a film-projection room at one end. The new building adjoins the London warehouse of the company.

The building is steel-framed, with reinforced-concrete hollow-tile floors. The walls to the streets are faced with 2-in. polished artificial stone slabs, cramped to brickwork with copper cramps. The back walls are faced with sand-lime bricks. Office subdivision on two floors is by glazed steel partitions. Other partitions are of hollow blocks plastered.

There is no special planning apart from the central staircase and the main entrance. This is planned in the centre of the Stamford Street frontage between Cornwall Road and Coin Street, as the present building is only a portion of the whole scheme, which will extend eventually up to the corner of the latter street. The staff lavatories and cloak-rooms are at the Cornwall Road end of the building, and are connected by the staff staircase. Maximum light is obtained by the use of continuous windows. The heights of all floors are greater than those in general use, and an air-conditioning plant keeps the air fresh in all rooms when windows must be closed. The chairman's office, board room, and conference room are specially sound-proofed, and have double windows and acoustically treated ceilings. Teas can be served on all floors, and two service lifts connect with the kitchen in the basement. Meals are served to the directors from the servery on the second floor.

There are two passenger lifts, one goods-passenger lift, and three food lifts. The heating is an extension of the present system, the service being carried in a tunnel from the warehouse under the goods yard. Flush panel radiators are used generally. Air-conditioning is provided to all floors by plant on the roof of the warehouse.

The canteen occupies the major portion of the basement. It is lighted by windows at street level and by pavement lights over the alcoves under the pavement. Seating accommodation is for 550 persons, and meals are served at a long counter, having sliding hatches in stainless steel, opening to the kitchen. The kitchen has opening top-lights, artificial ventilation, and extract ducts and canopies to carry off all the fumes from the cooking appliances. (*Architects: Messrs. Henry Tanner, F/F.R.I.B.A.*)

small areas is much larger than it is for large areas. This must be kept in mind when planning main corridors, staircases, or means of escape and lifts.

A large number of small tenants may be more trouble for the owner ; on the other hand, his liabilities are spread, and the loss of a tenant is not the serious matter it may prove in the case of a building let to a few large concerns.

The office units themselves, with means of access thereto, establish the main lines of the typical floor plan. Provision must be made for—offices ; main and subsidiary corridors ; staircases ; lifts ; lavatories for both sexes ; cleaners ; such services as may require space for ducts, ventilation, heating, telephones, etc.

Office Unit

Great variation of opinion is found with regard to the ideal office unit. It may, however, be accepted that 20 ft. to 25 ft. is the maximum depth desirable with natural light on only one side. Beyond this, artificial light is necessary, which adds to the maintenance or upkeep, and is bad for the general health of the tenant. A wing with a central corridor of, say, 5 ft., with offices on each side having natural light only on one side, will therefore be from 45 ft. to 55 ft. wide.

The width of individual office units is controlled to some extent by the steel grid or frame. Economic spans usually found vary from 15 ft. to 22 ft. centre-to-centre of stanchions. It is desirable that partitions should be placed along the lines of the beams.

Floor heights vary according to the type of office ; again, as in most commercial buildings, the problem usually results in that of providing as much lettable floor area as possible, thereby as many floors as possible in a height restricted by the local authority. A floor height of 10 ft. floor to floor is about the minimum ; 11 ft. is better, particularly if the offices are to be of any size. A height of 13 ft. floor to floor is not extravagant for large offices in which a large number of people may be employed. A useful rule of thumb is that the office should not exceed twice its height in width. Thus if it is necessary to have a relatively deep office with light on one side it becomes necessary to increase its height.

No tenant should have to walk more than 80 ft. to lift and staircase.

Corridors

Corridors giving access to offices must be wide, particularly if the corridor is of any length. A minimum width of 5 ft. is desirable. It should be remembered that cumbersome furniture, desks, files, etc., have to be moved, apart from the question of providing comfortable means of communication for tenants and visitors. As previously

Fig. 4.—BROADCASTING HOUSE, PORTLAND PLACE, LONDON

The elevations are faced with Portland stone, and the numerous office windows have been arranged to allow the utmost elasticity in internal subdivision. The sculptured group of Prospero and Ariel over the front entrance is the work of Mr. Eric Gill, as also are the panels at the base of the towers on Portland Place, and over the minor entrance in Langham Street. (*Architect: G. Val. Myer, F.R.I.B.A.*)

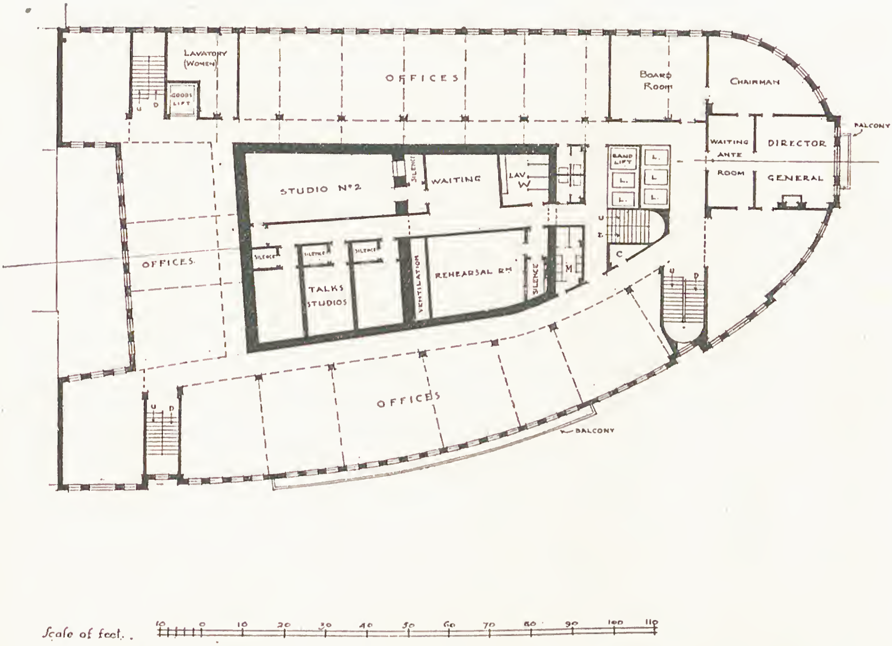


Fig. 5.—BROADCASTING HOUSE—PLAN OF THE THIRD FLOOR

This building was designed to accommodate the headquarters staff of the British Broadcasting Corporation, and to provide, also, some twenty studios, varying in size from a concert hall to small rooms for talks and "news." It consists of an outer ring of offices of steel-framed construction, encircling the massive central brick tower in which the studios are enclosed. As a result of this arrangement, practically the whole of the site has been built over to the full height, and there are no internal areas. The rooms within the tower, including lavatories, have no direct communication with the open air, and are ventilated by an elaborate air-conditioning plant. They are also artificially lighted. The tower is equipped with its own lifts and staircases, so that, once within its walls, the artistes may reach any desired studio without contact with the clerical staff or the public.

The studios, generally, alternate, floor by floor, with storerooms, music libraries, etc., so that, as far as possible, each floor of studios is isolated, in order to obviate the possibility of sound transference.

mentioned, apparent extravagance with regard to corridors, entrance halls, etc., may prove an asset in other directions.

Lifts and Staircases

Office buildings of type 1 frequently retain the main staircase as an architectural feature, though apart from tenants on the first floor it has little value except as a means of escape from upper floors. In general, and particularly in the case of tall buildings, the staircases may be considered primarily as means of escape, and planned and situated accordingly. In American skyscraper buildings the staircase is considered solely as a means of escape, is invariably totally enclosed, and no longer forms an architectural feature.

Fig. 6.—YORKSHIRE HOUSE, CROSS STREET, MANCHESTER —DETAIL OF ENTRANCE

This building was erected for the Yorkshire Insurance Co., who occupy the first and second floors, the ground floor being let as shops, and the upper storeys as offices. A sub-basement is provided with strong-rooms for storage purposes. The building is faced with Portland stone throughout. (*Architects: Oakley and Sanville, A/F.R.I.B.A.*)

Lifts should be grouped together as much as possible. This simplifies arrangements for traffic circulation, and also concentrates the necessary mechanical gear. In the case of small office blocks the lift is often put in the stair well. This arrangement is not very satisfactory, and is very unsightly. The only thing that may commend the practice is that space is saved. It will in general be found much better to place the lift or lifts in a separate enclosed lift shaft, an arrangement which reduces noise and draughts to a minimum, and allows of a reasonable architectural treatment to the entrance hall.

The following figures, obtained from Messrs. Marryat and Scott, are of interest :—

Lift Car Capacity in Persons	*Speeds in Feet per Minute*			*Approximate Sizes of Lift Car*	
	120	200	350		
	Persons Conveyed per Hour from above First-floor Level to Ground			*Width*	*Depth*
				ft. in.	*ft. in.*
3	165	210	246	2 9	3 6
4	208	256	300	3 0	4 0
5	245	300	345	3 3	4 3
6	282	336	384	3 6	4 3
8	336	400	448	4 3	4 6
12	432	492	540	5 0	5 3

An average of 75 ft. super reckoned on the gross floor area should be allowed per person for calculating the potential number of persons to be conveyed.

It should not be necessary to wait for more than 45 to 60 seconds for a lift.

In America the lift battery is the most important consideration in a tall office building—it may amount to 10 per cent. of the total constructional cost. In this country, owing to restricted building heights, we are not faced with many of the lift problems met elsewhere—high running speeds, large batteries, etc.

Details of the placing, sizes, construction, etc., of staircases are controlled by the local authority according to the regulations controlling means of escape. Occasionally the traditional feature of the grand staircase is retained from ground to first floor only; above first floor it is relegated to a comparatively unimportant position, and used as an escape stair.

The Town Planning Act in London gives the authorities powers to object to the old type of open, iron, external staircase used for escape if in their opinion it is likely to be an eyesore, and objected to by adjoining owners. In actual fact an enclosed staircase is much better, though of course it necessarily takes up valuable letting space, which

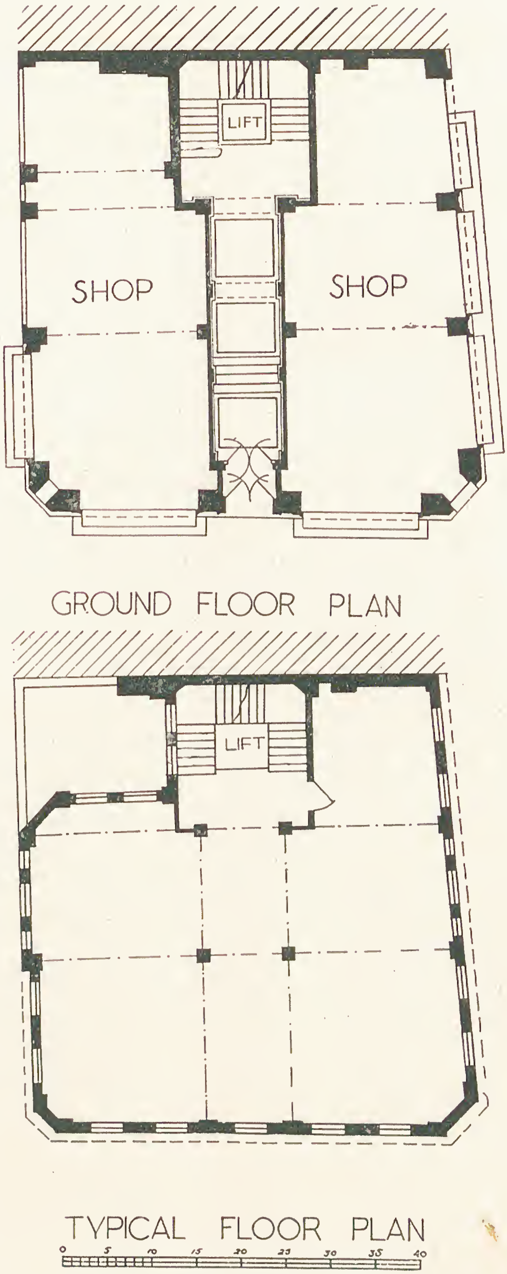


Fig. 7.—YORKSHIRE HOUSE, CROSS STREET, MANCHESTER
(*Architects: Oakley & Sanville, A/F.R.I.B.A.*)

in these days of high ground rents and values is an important consideration.

Lavatory Accommodation

There is again considerable difference of opinion as to the position in which lavatory accommodation should be placed. The various possibilities comprise :—

(*a*) Lavatory accommodation for both sexes placed on each floor.

(*b*) Lavatory accommodation for the different sexes placed on alternate floors.

(*c*) All the lavatories on the top floor.

(*d*) All the lavatories in the basement.

Each method has its adherents, its advantages, and disadvantages, and the details of the plan in great measure control the position best suited to individual cases.

(*a*) Useful in cases where the lavatories can be placed in blind places in the plan, i.e. where the light is not good enough to allow of letting as office space. In London it is now no longer necessary to have lavatories on an outside wall, which facilitates the planning avoiding the necessity of taking up valuable light for such a purpose. In this arrangement minimum time is wasted by employees. The sexes have to be adequately separated.

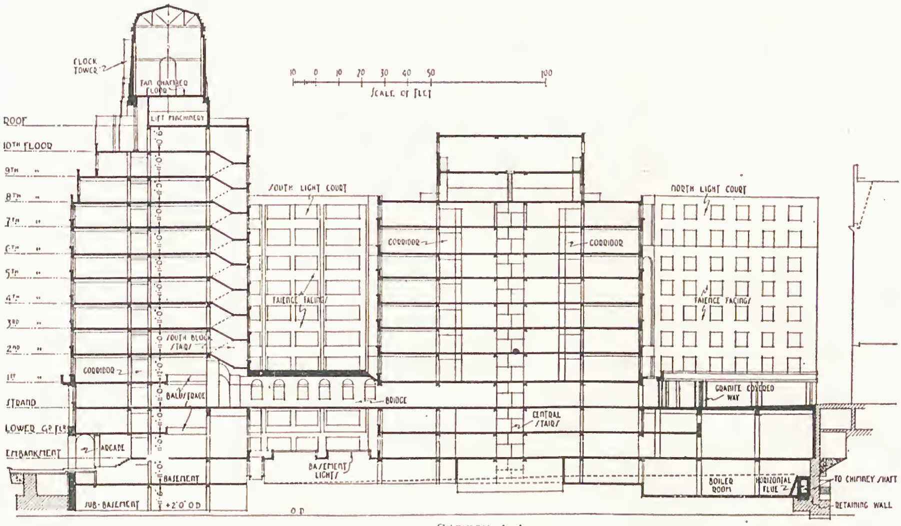
(*b*) This arrangement allows of simple segregation of the sexes, and is very workable in practice.

(*c*) and (*d*). These arrangements have the disadvantage that they are not quite so convenient, and that there is the possibility of much time being wasted by employees, though with adequate lift service it would appear to be not very serious. The arrangements have the advantage of concentrating the plumbing services, and leave the whole of the floor space on each floor free for office use. This may be particularly useful, say, in a case where good light is available on all sides of the site. It would obviously be wasteful in this case to take up valuable light on each floor for lavatory accommodation. Much space is also saved by the reduction of the number of lobbies, etc., to a minimum.

LAVATORY ACCOMMODATION NECESSARY

MALES

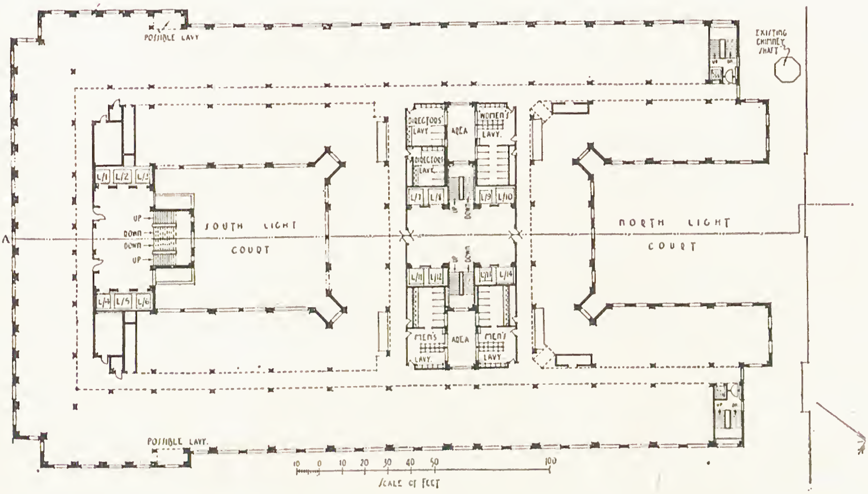
Number of Persons	*Number of W.C.s*	*Number of Lavatory Basins*	*Urinals*	
			No. of Persons	*Number of Stalls*
1–15	1	1	7–20	1
16–30	2	2	21–45	2
31–65	3	3	46–70	3
66–100	4	4	71–100	4



SECTION A.A.

[*By courtesy of "Building"*

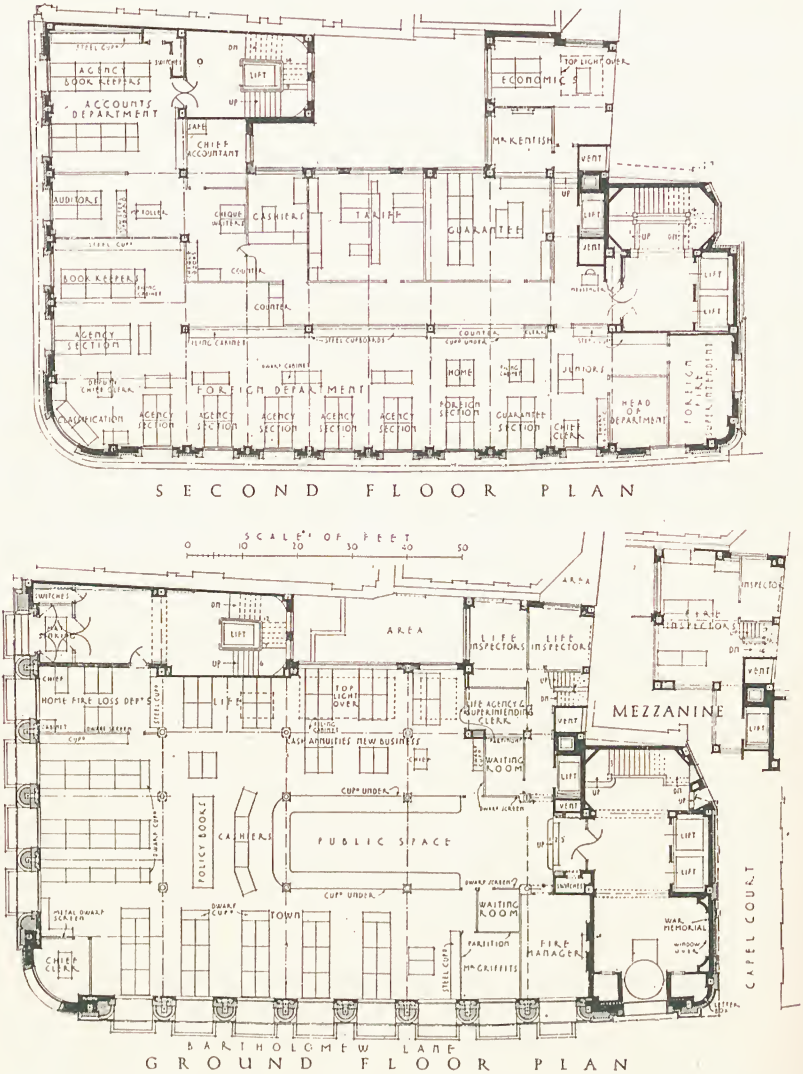
Fig. 8.—SECTIONAL ELEVATION, SHELL-MEX HOUSE, EMBANKMENT, LONDON
(*Architects : Messrs. Joseph.*)



[*By courtesy of "Building"*

Fig. 9.—SECOND-FLOOR PLAN, SHELL-MEX HOUSE

Note central grouping of lavatories, directly communicating with small sanitary areas. Notice also central grouping of lifts and stairs on each side of central hall.



[*By courtesy of* "*Building*"

Fig. 10.—GROUND- AND SECOND-FLOOR PLANS, ALLIANCE ASSURANCE OFFICES, LONDON

Entrance hall lined with polished Portland stone. Counter front of same material, with top of teak. Sub-basement accommodates boiler house, air washers, refrigeration plant, oil tank, water-softening plant, tenants' strong-rooms, and chief fire- and burglar-proof strong-room. Basement contains upper part of boiler room, transformers, and further strong-rooms. Lower ground floor contains staff lunch room, staff lounge, kitchen, men's staff lockers and men's and women's lavatories. Most of staff lavatories are arranged on lower ground floor. (*Architects : Joseph and Mewes and Davis, F.R.I.B.A.*)

FEMALES

Number of Persons	*Number of W.C.s*	*Number of Lavatory Basins*
1–12	1	1
13–20	2	2
21–40	3	3
41–60	4	4
61–80	5	5
81–100	6	6

In addition to general lavatory accommodation, private lavatories are usually required for heads of departments, directors, etc. In America it is felt desirable to include a lavatory basin in every office, though this is not the practice in this country.

Materials

The choice of materials varies according to the type of building, though in general it is limited by the necessity of keeping annual maintenance and depreciation as low as possible. A high initial capital expenditure may be more than justified if the annual upkeep is small. In cases of buildings built as an investment this is obvious. In the case of a speculation, i.e. a building which is put up by a promoter with a view to letting and ultimately selling, the balance of initial capital expenditure as against annual maintenance is not so easy to adjust. Maintenance is not the promoter's interest except in so far as he must, of course, not frighten away the investor by a scheme of development which will be costly or uneconomic to run ; on the other hand, increased capital expenses reduce his profit on the ultimate sale. The problem in this case is usually that of providing the minimum reasonable requirements of a prospective investor in as economical a manner as possible.

Modern office buildings are now invariably of fire-resisting construction, i.e. a steel or reinforced-concrete frame with solid floors. The walls externally may be brick, stone, glass, faience, etc. A great deal of interest is now being displayed in the possibilities of faience. All manner of finishes and colours are available, it is easily cleaned, and the maintenance cost is low.

Wood-block flooring is much used, though requiring a good deal of attention. Rubber flooring of various kinds, and lino, are also good and frequently used.

BANKS

Architecturally speaking, banks come under one of two categories :—

(*a*) The branch bank.

(*b*) The head office, or headquarters of the central organisation.

It will be found on examination that many elements of the plan are similar in both cases ; on the other hand, the wider and more extensive

field represented by the head office introduces certain elements not required in the branch bank.

Generally speaking, the planning problem in connection with a bank is comparatively simple. The principal requirements are :—

(*a*) *Basement.*—Strong-rooms, book rooms, staff lavatories, such mechanical gear as may be necessary—lifts, heating, ventilation, etc.

(*b*) *Ground Floor.*—Main banking hall, public space, manager's office and waiting-room, accommodation for clerks.

(*c*) Upper floors may accommodate directors' rooms, reception rooms, etc., canteen, rest and recreation rooms for staff, while above may be several floors of offices sublet to individual tenants and having their separate entrance from the street. A more detailed description of the individual elements follows later.

The basic idea in connection with the design of a bank, or at least the large banks, has been to produce an effect of solidity and dignity in keeping with the alleged reliability of the institution. Any suggestion of eccentricity, experiment, or levity has yet to be seen in connection with a bank. A traditional type of architecture has to date been accepted as an essential. The small branch banks are a little more intimate, and considerable variation in treatment may be observed.

Branch Banks

It was at one time thought that corner sites were favoured for branch banks primarily on account of their position. In actual fact the exigencies of the plan render the layout better if light is available on two sides. Comparatively little frontage is required—some 25 ft. to 30 ft., though a good depth is essential.

A more recent tendency is for banks to place small branches in the middle of shopping centres, i.e. one of the units designed for a shop is taken over by the bank and fitted up as a branch. Originally the bank manager used to live over the bank, but owing to this new tendency to lease a portion of a building, instead of erecting a complete building, this is now rarely the case. The new arrangement has also necessitated a change in the architecture of the branch bank, which is now invariably evolved to fit a preconceived scheme as well as possible.

Requirements

A main entrance door, preferably to one side to allow maximum light into the banking space ; this door should have a good lobby, with draught doors to prevent the disturbing of papers when the doors are opened.

The counter decides the planning of the banking space. This counter should not be less than 3 ft. 3 in. high and 4 ft. wide, if not provided with a grille. Most banks issue standard and explicit instructions in these matters in connection with branch banks.

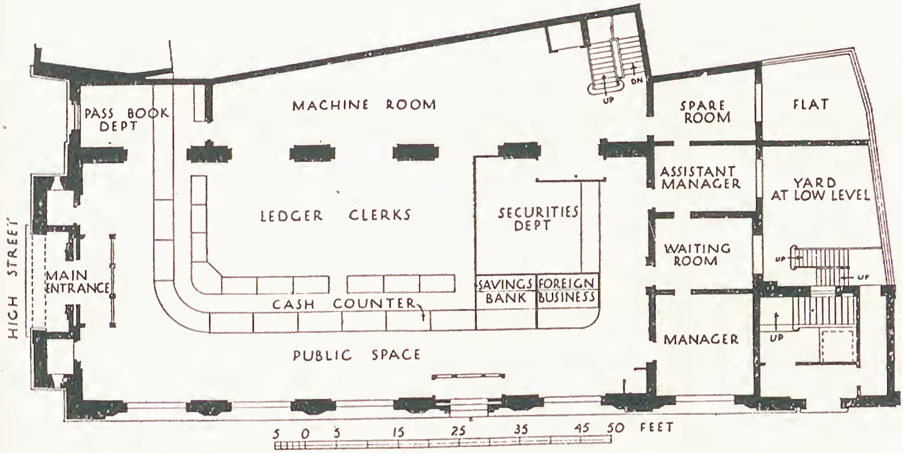
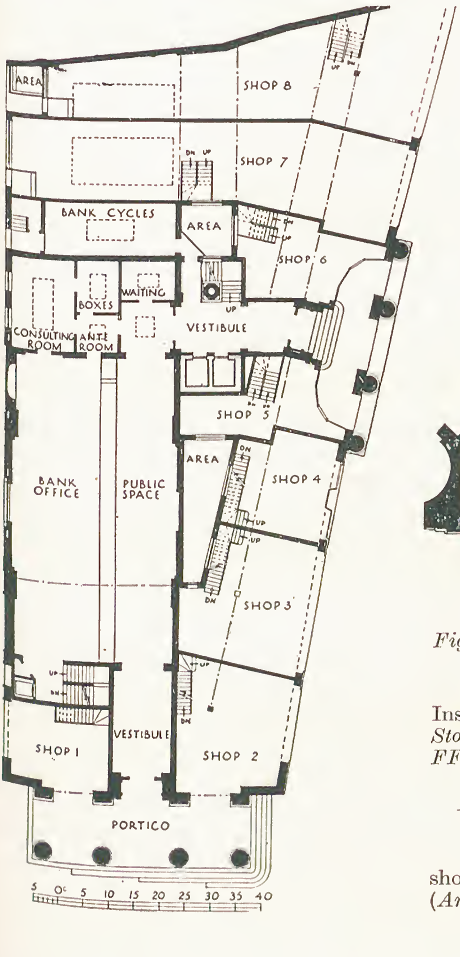


Fig. 11 (*above*).—LLOYDS BANK, COVENTRY

(*Architects : Buckland and Haywood, FF.R.I.B.A.*)



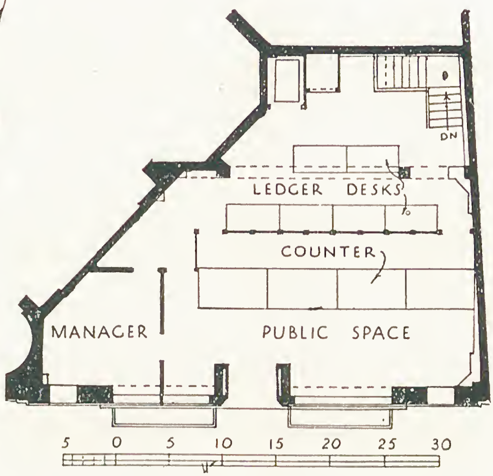


Fig. 12 (*above*).—PLAN OF MARTIN'S BANK, LEICESTER

A branch bank accommodated in the Royal Insurance Company's Building. (*Architects : Stockdale Harrison & Sons and George Nott, FF.R.I.B.A.*)

Fig. 13 (*left*).—PLAN OF THE NATIONAL PROVINCIAL BANK, COVENTRY

Example of large provincial branch in central shopping centre. Note the two porticoes. (*Architect : the late F. C. R. Palmer, F.R.I.B.A.*)

The length of counter is determined by the number of cashiers employed ; a length of 6 ft. is really advisable to each cashier, to allow adequate knee-space, a till drawer on his left-hand side, and a pedestal of drawers, for vouchers, etc., on his right. A space of 3 ft. 6 in. to 4 ft. is desirable behind the counter to facilitate comfortable working for cashiers. Behind the cashiers are placed the clerks, who are separated from the cashiers by a screen in which there is a door giving access to the counter. The cashier thus has control of both the public in front of the counter and the staff behind the counter. About four or five times the area required for cashiers is necessary for the clerks, i.e. the area required for four cashiers would require accommodation for sixteen to twenty clerks. Desk space of 4 ft. by 2 ft. 3 in. is required for each clerk.

The manager's room is usually placed at the end of the counter, at the far end of the banking hall. Sometimes a waiting-room is attached, and entrances from the public space at the front and to the staff at the rear are necessary. The manager's room should have good light and ventilation, and comfortably seat a meeting of four or five.

The public space at the front should have a minimum width of 10 ft.

Strong-rooms may be placed on the same floor as the banking hall or, if the site is restricted, may be situated in the basement. A rough guide of 50 ft. super to each cashier is given by the authorities as the approximate space required. Provision should be made for safe storage of articles deposited by customers, securities, cash, book room. In larger banks the strong-rooms usually form a separate island surrounded by a patrol corridor which is just wide enough to allow adequate supervision and yet too narrow to allow burglars to work. Mirrors are sometimes placed at the angles to allow of supervision all round the patrol corridor. Protection is required against fire, water, flood, riots, air raids, etc.

Staff lavatories, heating, etc., are usually placed in the basement also.

Head Offices

On examination it will be found that most of the above requirements are repeated on a larger scale, together with the addition of facilities necessary for dealing with such items as the issuing of shares, bills, foreign exchange, stockbrokers, etc. The arrangements in connection with the strong-rooms are again more involved, and it is, of course, not possible to obtain illustrations of such planning for specific cases ! ! Bullion lifts are of course necessary when the strong-rooms are in the basement. A great deal of space is taken up by staff lavatories, cloak and locker rooms, rest rooms, canteen, etc. In a head office a staff of hundreds has to be catered for. In addition, committee rooms, board room, directors' and secretary's offices, smoking-rooms, etc., have all to be provided on a somewhat lavish scale.

AERODROMES AND AIRPORTS

PART I.—PLANNING AND DESIGN OF LANDING-AREA

IT is no exaggeration to say that for the adequate development of civil aviation in this country upwards of two hundred more aerodromes are required, and the following cannot pretend to do more than draw attention to a few of the principal considerations affecting layout and design of airports and aerodromes.

All aerodromes must be licensed by the Air Ministry, which has laid down the minimum dimensions for the landing-areas for various types of aerodromes according to the landing and taking-off characteristics of the machines which use them.

A system of classifying licensed aerodromes intended for permanent use by means of an index has been adopted for the purpose of giving a general indication of their dimensions and facilities. Aerodromes are graded into six classes, A, B, C, D, E, and F, according to their dimensions, which are tabulated below.

CLASSIFICATION OF AERODROMES

Class	*Length of Effective Runway*	*Minimum Width of Runway*	*Directions*
A . .	800 yd. or more	200 yd.	All
B . .	800 to 700 yd.	200 yd.	All
C . .	700 to 600 yd.	200 yd.	All
D . .	600 to 500 yd.	200 yd.	All
E . .	500 to 400 yd.	200 yd.	All
F . .	400 to 300 yd.	150 yd.	All

Aerodromes are also classified, according to the facilities on the aerodrome, by the numbers I, II, III. The significance of these numbers is shown in Appendix I of the Air Ministry pamphlet No. 55, issued by the Directorate of Civil Aviation, and to which the reader is referred for further information.

Aerodromes are further classified, according to the provision of night-flying equipment, in classes *a*, *b*, and *c*. The significance of these letters is shown in Appendix IV to the above-mentioned publication.

Runways

The term " effective runway " means a runway reduced in length by any necessary corrections for the presence of obstructions in the line of the intended take-off or landing.

Corrections are made according to the formula :—

$$D = 10H - d$$

where

D = Distance in feet by which the runway is decreased.
H = Height of the obstruction in feet above the ground level.
d = Distance in feet of the obstruction from the perimeter of the landing-area.

The foreword to the pamphlet above referred to states :—

" It is envisaged that, in future, sites intended for development as municipal aerodromes for use by heavy air-line traffic should preferably conform at least to a size affording in three directions runways of 1,000 yds. in length and 200 yds. in width, and in the fourth direction 1,300 yds. in length and 400 yds. in width. These four directions should intersect at angles of 45 degrees.

" It may not, however, be necessary at the outset to prepare the whole of the selected area for landings ; but if the probable requirements of future traffic are to be catered for, provision for extensions to the landing-area should be made at the outset, and sufficient land capable of development acquired for the purpose, in order that it may ultimately be enlarged to the dimensions stated above when traffic considerations render this necessary."

The Chief Technical Assistant, Civil Aviation Department, Air Ministry, states that with an eye to the future we must allow 1,400 yd. in the main direction, and not less than 1,000 yd. in all other directions.

A first-class airport requires a landing-area of about 200 acres, but half this area would be sufficient for a minor airport not yet called upon for heavy traffic. Steps, however, should be taken to obtain control of considerably greater areas around the boundaries, as otherwise obstruction in the form of factory chimneys, high buildings, wireless masts, etc., might conceivably impair flying safety to such an extent as to render the airport completely useless. Such circumscribing ground can, however, be developed under control within the limits required by the safeguarding of the airport which it encloses.

Surface

Paragraphs 3 and 4 of the Air Ministry pamphlet lay down the requirements for the surface and gradients of aerodromes as below :—

" 3. (*a*) The surface of an aerodrome must be even and smooth enough to allow a motor-car to be driven over it at 20 miles per hour without inconvenience to the occupants.

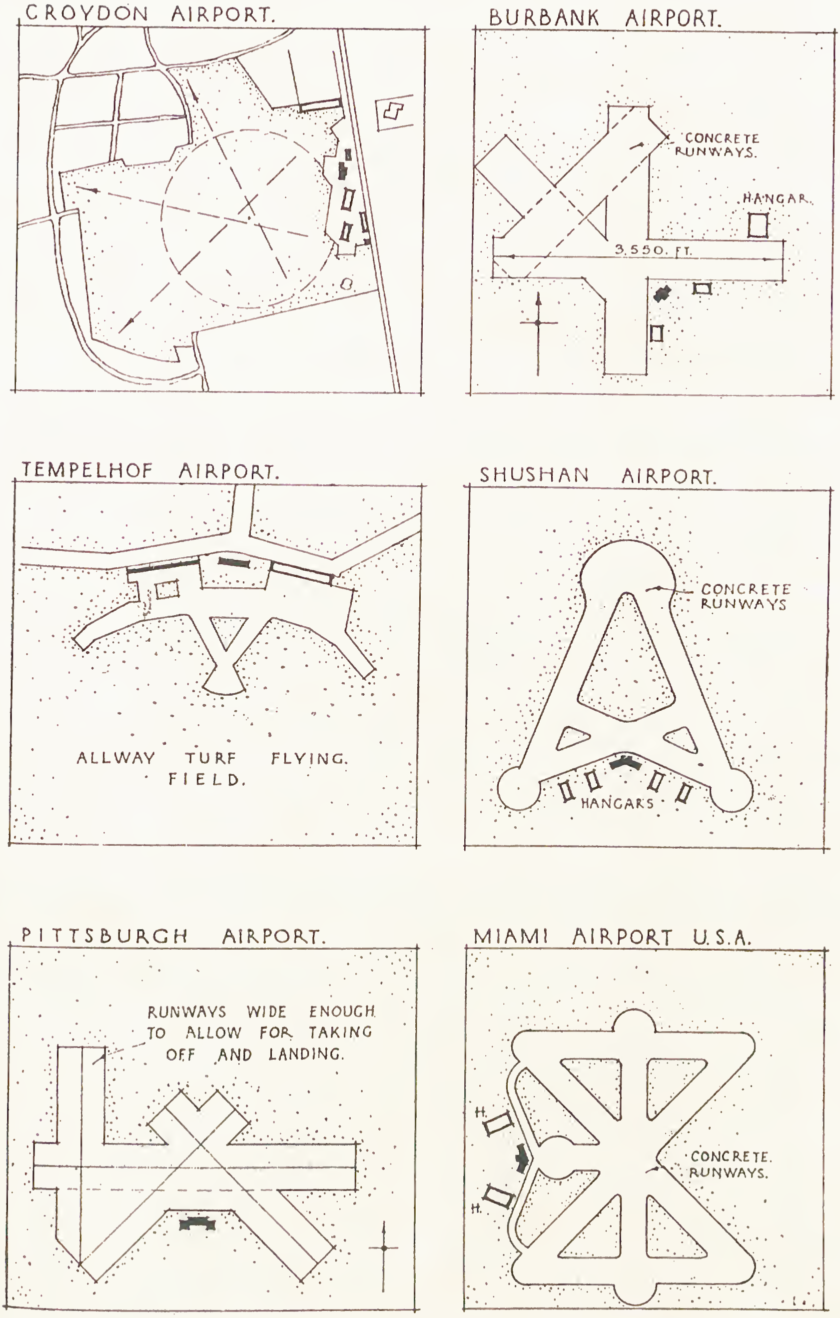


Fig. 1.—Diagrammatic layout of various types of aerodromes

" (*b*) The surface is to be composed of either turf or some artificial or natural substance strong and firm enough to withstand without permanent damage a pressure of two and a half tons per square foot. Any culvert or bridge within the landing-area is to be capable of taking without permanent damage to the surface an impact load of five tons per square foot.

" (*c*) The landing-area must be well-drained and be practicable for the operation of aircraft under ordinary weather conditions.

" (*d*) The surface must be free from molehills, rabbit holes, ridge and furrow, wheel ruts, or any impediment of any nature whatsoever which might cause damage to any type of aircraft.

" (*e*) Grass on the surface of a landing-area must not be allowed to grow long. At no time may the length of the grass be such as to endanger even the lightest type of aircraft.

" 4. The over-all gradient of the landing-area is not to exceed 1 in 50. The actual gradient of any particular undulation is not to exceed 1 in 40."

Obstructions

" 5. Whatever may be the direction of the wind, it must always be possible for aircraft to approach the landing-area in the normal manner, unhampered by any obstacle or obstruction. The definition of an obstruction for the purpose of this paragraph is as follows :—

> " Any object beyond the perimeter and within half a mile of the aerodrome which subtends a vertical angle of more than 3° 45′ measured from the nearest point on the perimeter.

" The presence of overhead electric cables within one mile of any aerodrome is highly undesirable, and may make it necessary for the licence to be withheld, or special conditions to be attached to it."

Site Preparation

A slight fall towards one or more sides of the landing-area greatly assists natural and artificial drainage. At the Singapore air base " doming " has proved effective in dealing with the heavy rainfall, and this 1,000-yd.-diameter area remains in excellent condition at all times, because the water quickly runs off all round the perimeter.

A rough test for smoothness is to drive a motor-car at 20 miles an hour over the surface ; it should be possible to do this without discomfort to the passengers. A 3-ton lorry driven slowly over the field indicates sufficient strength in a grass-surfaced field if the wheels do not sink in appreciably.

Drainage

The provision of an efficient drainage system on an aerodrome is a necessity. Natural drainage of the site will depend upon the nature of

the subsoil, which can be ascertained by trial borings at intervals to reveal the level of standing water. An examination of the strata will give an indication of the permeability of the soil.

A quick run-off of water from an aerodrome surface is essential, and open ditches are, of course, out of the question.

The spacing and size of drains required is calculated on the basis of the removal of one hour's rainfall of maximum intensity within three hours of its commencement. The run-off factors of various types of surface are as follows :—

Well-drained turf	about 5 per cent.
Tarmac	,, 70 per cent.
Asphalte	,, 75 per cent.
Concrete	,, 80 per cent.

Surface-water drains filled with clinker or other suitable material may sometimes be used where there is a porous substratum available, but a subsoil drainage system is usually necessary for the rapid removal of the surface water and the lowering of the water table.

The loads on pipes laid under aerodrome surfaces are considerable, as is shown by the following Table :—

LOADS ON PIPE

DUE TO A 30,000-LB. AEROPLANE LANDING WITH AN IMPACT FACTOR OF 3 (IN POUNDS PER FOOT RUN OF PIPE)

Diameter of Pipe	*Depth of Top of Pipe below Surface*				
	1 *ft.*	2 *ft.*	3 *ft.*	4 *ft.*	5 *ft.*
6 in.	9,200	2,580	1,170	660	420
12 in.	11,200	4,350	2,160	1,275	825
24 in.	16,000	7,650	4,060	2,440	1,620

Porous-concrete pipes are widely used, because of their strength and permanence. Six-in. porous-concrete pipes laid with dry ogee type of joints are suitable for laterals, and from 12-in. to 18-in. porous-concrete pipes for the main collectors. The arrangement can be seen from the cross-sections given in Fig. 6.

The layout of lateral drains usually follows the natural, herring-bone, gridiron, or parallel systems.

Aerodrome Markings

Air Ministry pamphlet No. 55 gives the details of markings recommended for all permanent aerodromes, and states that these should be of chalk, concrete, or other substance which will show up well against the natural colour of the aerodrome surface. The outlines of the principal

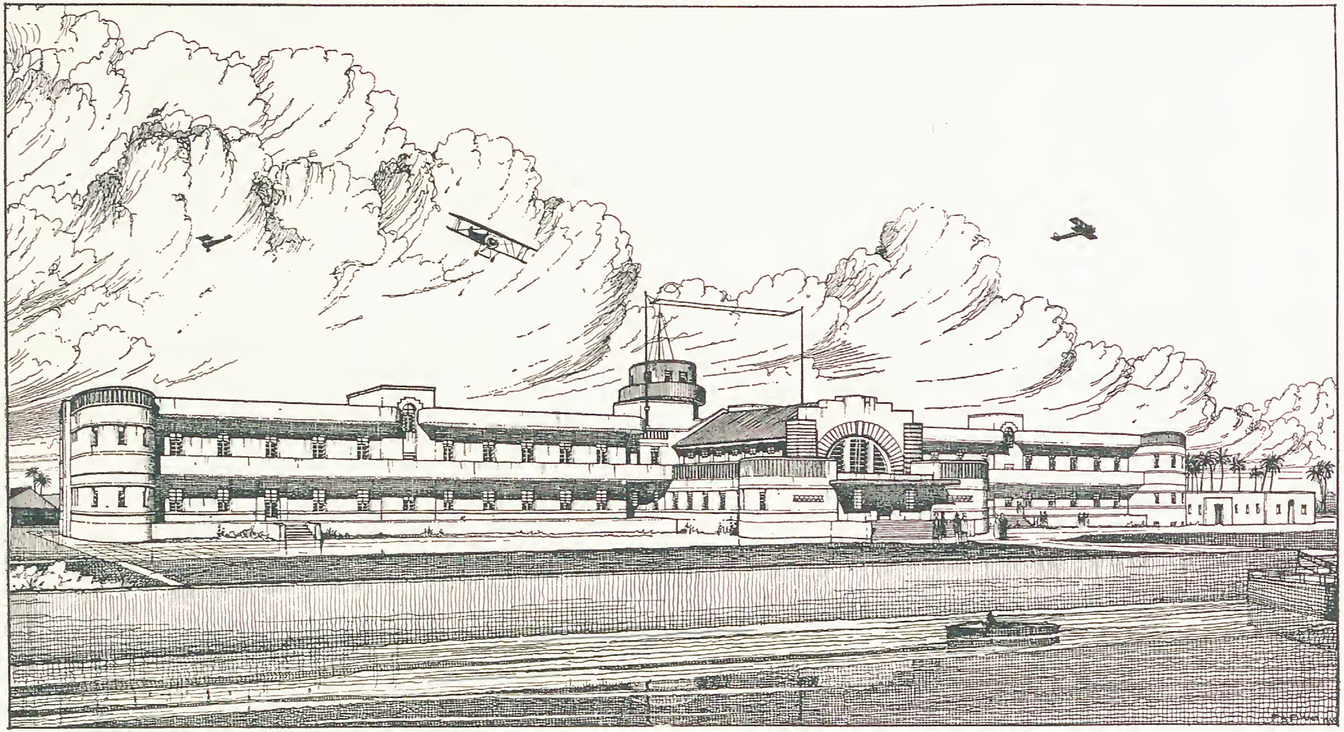


Fig. 2.—BASRAH AIR PORT TERMINAL BUILDING

Aerodrome suitable for landing by largest types of aircraft in all weathers, to permit of which central area and four principal runways are covered with all-weather bituminous surfacing. Runways are 100 yd. in width and 1,000 to 1,200 yd. in length. Hangar provided for largest types of machines is about 275 ft. long, 140 ft. wide, and gives a clear head-room of some 40 ft. Main building is situated on bank of River Shett-el-Arab.

Materials used in construction are local bricks, which are yellow in colour. The local practice of using thick walls has been followed. Floors and roofs are of brick jack arching carried on light filler rolled-steel joists. Balconies are in reinforced concrete carried on cantilever rolled-steel joists. Accommodation provided on ground and first floors is shown on plans, Figs. 3 and 4. (*Architects : J. M. Wilson, A.R.I.B.A., and H. C. Mason, O.B.E., F.R.I.B.A.*)

markings are given in Fig. 5, and it is recommended that these be constructed of concrete owing to the permanence afforded by this method of construction, and the fact that after six years of maintenance chalk markings usually work out more expensive.

In a long straight length of concrete marking, expansion joints should be provided at not more than 35-ft. intervals. The usual type of expansion jointing material used in road construction is, of course, suitable.

Layouts of Aerodromes

An aerodrome should be laid out so as to provide for safe landing and taking-off in any direction, and the aerodrome buildings should be placed with a view to providing speed of interchange between ground and air traffic, and also to provide the maximum safety of aircraft using the aerodrome.

Considerations of safety demand that the buildings should be remote from the landing-field. On the other hand, the necessity for the quick interchange of traffic from land to air requires that the aerodrome building be placed as close as possible to the landing-field.

The actual arrangement, therefore, represents a compromise, and a number of suggestions is shown in Figs. 1 and 5.

The station should, of course, be situated in a commanding position, as the control room associated with it is the nerve centre of the whole organisation. The control room is usually a tower, from which the control officer can command a view of the whole of the airport and of the arrival and departure of planes along the various routes. The control tower should be kept as low as possible consistent with the provision of an adequate view, and the station should be as close to the road or rail approaches as is convenient.

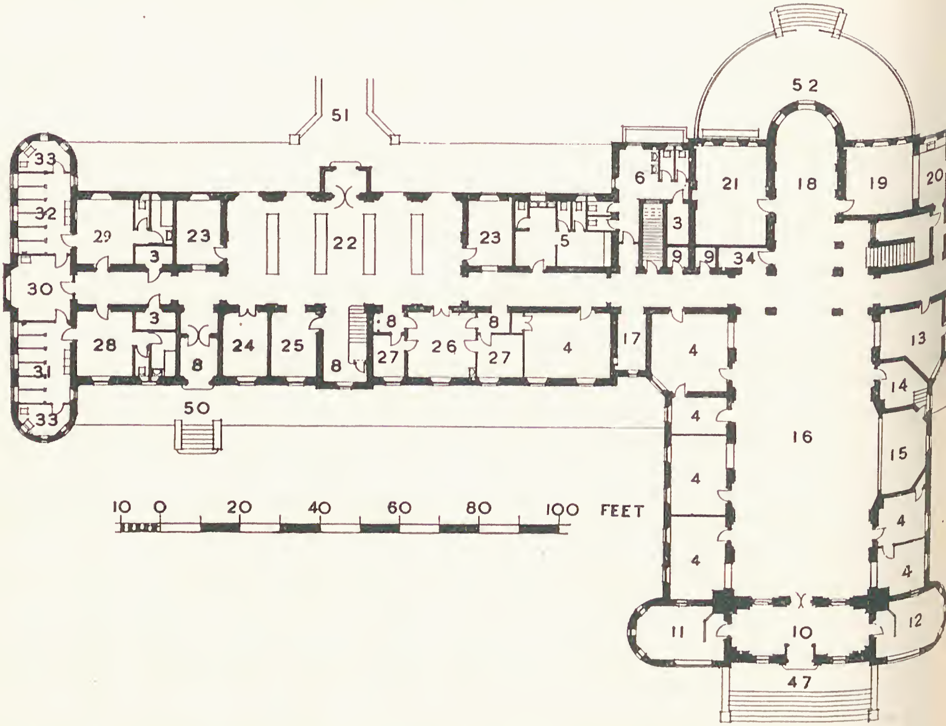
On the typical arrangements shown in the illustrations, the station is filled in black, and hangars shown as H. The airport buildings are dealt with separately in a following section.

Docking problems for aircraft have a dominating influence on the layout of the aerodrome, and special arrangements are often necessary to deal with the protection of the passengers as well as the control of visitors to the airport.

Extended canopies, to protect the passengers from the weather and from the slipstream of the propellers of the aircraft, are being widely adopted, and these must necessarily be of portable form, so that when not in use they are rolled back out of the way. Details of such an arrangement are given in the section on aerodrome buildings.

Landing-area

The landing-area should preferably provide all-ways landing facilities, but prepared surfaces restricted to certain definite runways are often a necessity. Strips may be laid down to give eight-way, or in some cases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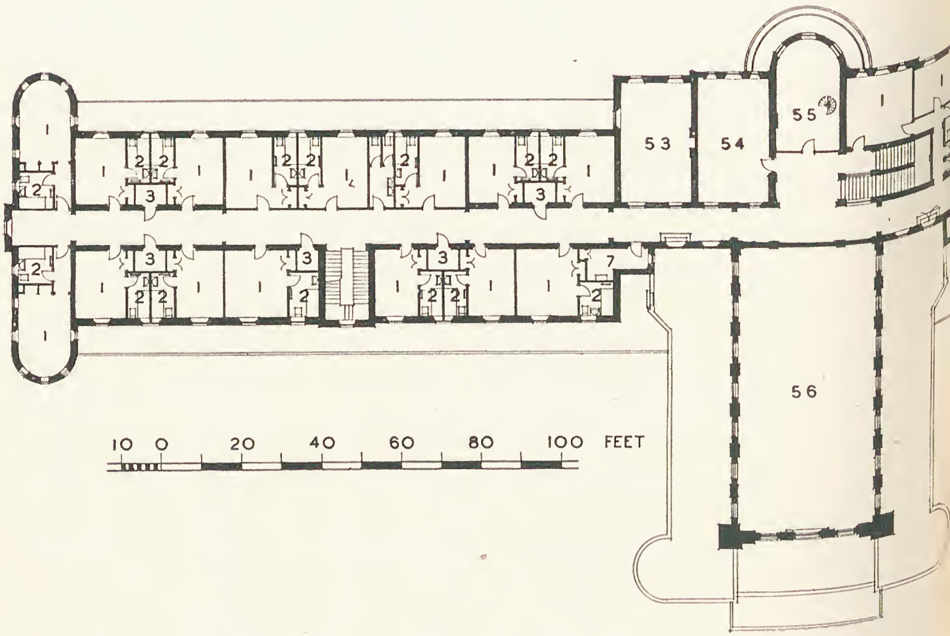
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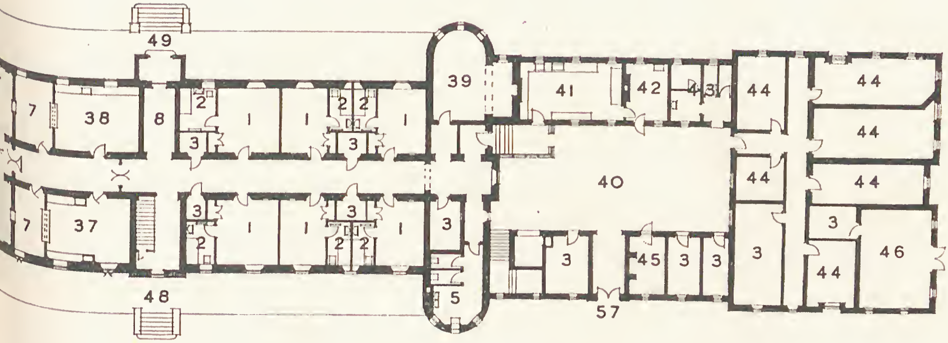


Fig. 3.—GROUND FLOOR, AIR PORT TERMINAL BUILDING, BASRAH, IRAQ

Key to rooms is given on next page. A view of the building is shown on page 550. (*Architects : J. M. Wilson, A.R.I.B.A., and H. C. Mason, O.B.E., F.R.I.B.A.*)

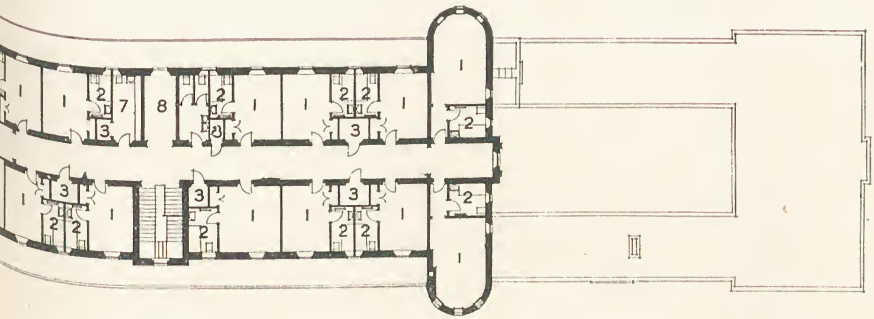


Fig. 4.—FIRST FLOOR, AIR PORT TERMINAL BUILDING, BASRAH, IRAQ

Key to rooms is given on next page. Second and third floors consist of control towers commanding unobstructed views in all directions. (*Architects : J. M. Wilson, A.R.I.B.A., and H. C. Mason, O.B.E., F.R.I.B.A.*)

BASRAH AIR PORT

KEY TO ROOMS OF MAIN BUILDING, AS SHOWN ON PLANS (FIGS. 3 AND 4)

1. Bedroom.
2. Bathroom.
3. Store.
4. Operating Companies' Office.
5. Gentlemen's Lavatory.
6. Ladies' Lavatory.
7. Service Room.
8. Lobby.
9. Telephone Box.
10. Main Vestibule.
11. Ladies' Cloakroom.
12. Gentlemen's Cloakroom.
13. Hotel and Traffic Office.
14. Private Telephone Exchange or Retiring Room.
15. Platform.
16. Main Hall.
17. Post Office.
18. Public Space.
19. Bar.
20. Bar Service.
21. Waiting-room.
22. Customs Hall.
23 Customs Office
24 Mails and Store.
25. Passport Office.
26. Medical Inspection Room.
27. Dressing-room.
28. Waiting-room—females.
29. Waiting-room—males.
30. Laboratory.
31. Stool Room—females.
32. Stool Room—males.
33. Stool Disposal.
34. Bookstall.
35. Lift.
36. Restaurant.
37. Kitchen.
38. Scullery.
39. Pilots' Sitting-room.
40. Menials' Yard.
41. Spare Kitchen.
42. Spare Scullery.
43. Menials' Bath and Lavatory.
44. Servants' and Menials' Quarters.
45. Servants' Cooking.
46. Electric Sub-station.
47. Main Entrance—river side.
48. Pilots' Entrance—river side.
49. Pilots' Exit to Aerodrome.
50. Mails Entrance—river side.
51. Passengers' Entrance to and Exit from Aerodrome.
52. Spectators' Entrance to Aerodrome.
53. Passengers' Lounge.
54. Writing-room.
55. Central Office and Wireless, etc.
56. Upper part of Main Hall.
57. Menials' Entrance.

The Air Port terminal building illustrated, at the Port of Basrah, Iraq, was erected by the Government of Iraq, the actual work of construction being undertaken by the Port Directorate, Basrah, under the administration of Colonel J. C. Ward (Retd.), C.M.G., C.I.E., D.S.O., M.B.E., M.Inst.T.

only four-way, landing facilities, as shown in the various arrangements illustrated.

These prepared surfaces should be as resilient as is possible, consistent with the provision of a dustless surface.

Cheapness of first cost and maintenance are also serious considerations. Various treatments, such as concrete, rolled-in slag, clinker, and asphalte, can be used, and in sandy districts crude oil rolled into the natural surface of the land can give satisfactory results. Concrete is unquestionably the most suitable material for aprons and paved areas in aerodromes, and its use is rapidly becoming standardised. It provides a clean, waterproof, and reasonably dustless surface, unaffected by oils and grease, and above all has a high reflecting coefficient, showing a good contrast between the surface of the runways and the land of the unpaved aerodrome.

Concrete-paved Surfaces

All concrete-paved surfaces on aerodromes are best laid in squares, and if the subsoil is absorbent and likely to draw water from the wet concrete when deposited, waterproof paper should preferably be laid down first and the concrete deposited on top of it. The squares may be 5 ft. by 5 ft. by 4 in. thick un-reinforced, 10 ft. by 10 ft. by 6 in. un-reinforced, or as much as 20 ft. square, 4 in. thick, reinforced with a mild-steel mesh of reinforcement to weigh approximately 5 to 7 lb. per square yard. When the small squares are adopted, it is quite satisfactory to separate them with wooden lathing, left in place to form expansion and contraction jointing. This is undoubtedly the cheapest method, and for the smaller aerodrome gives entirely satisfactory results. On the other hand, larger thicknesses are required for the heavier machines, and in America the minimum thickness is regarded as 6 in. It is desirable to lay the concrete on a consolidated hard-core base, except in very soft places, where weak concrete is used to make up the sub-grade. A pleasing arrangement is to lay the slabs chequer-board pattern diagonally to the runways and aprons, and also to use a two-colour scheme by means of a coloured cement in the topping. This reduces the glare, and adds very considerably to the interest of the surface. When the slabs are 10 ft. or over, premoulded jointed materials, such as cork or bitumen, as used in concrete road works, should be used between the slabs to provide for expansion and contraction.

If the greatest possible economy is required in construction, the special expansion joints could be limited to a spacing of approximately 40 ft. in each direction ; the joints between the expansion joints should be made dry by the tamping of the fresh concrete against the set concrete of the adjoining square, without the use of any grouting or special form of toothed bonding. This arrangement ensures that contraction cracks occur generally along the lines of division between the squares, and the unsightly appearance of crazed patterns is avoided.

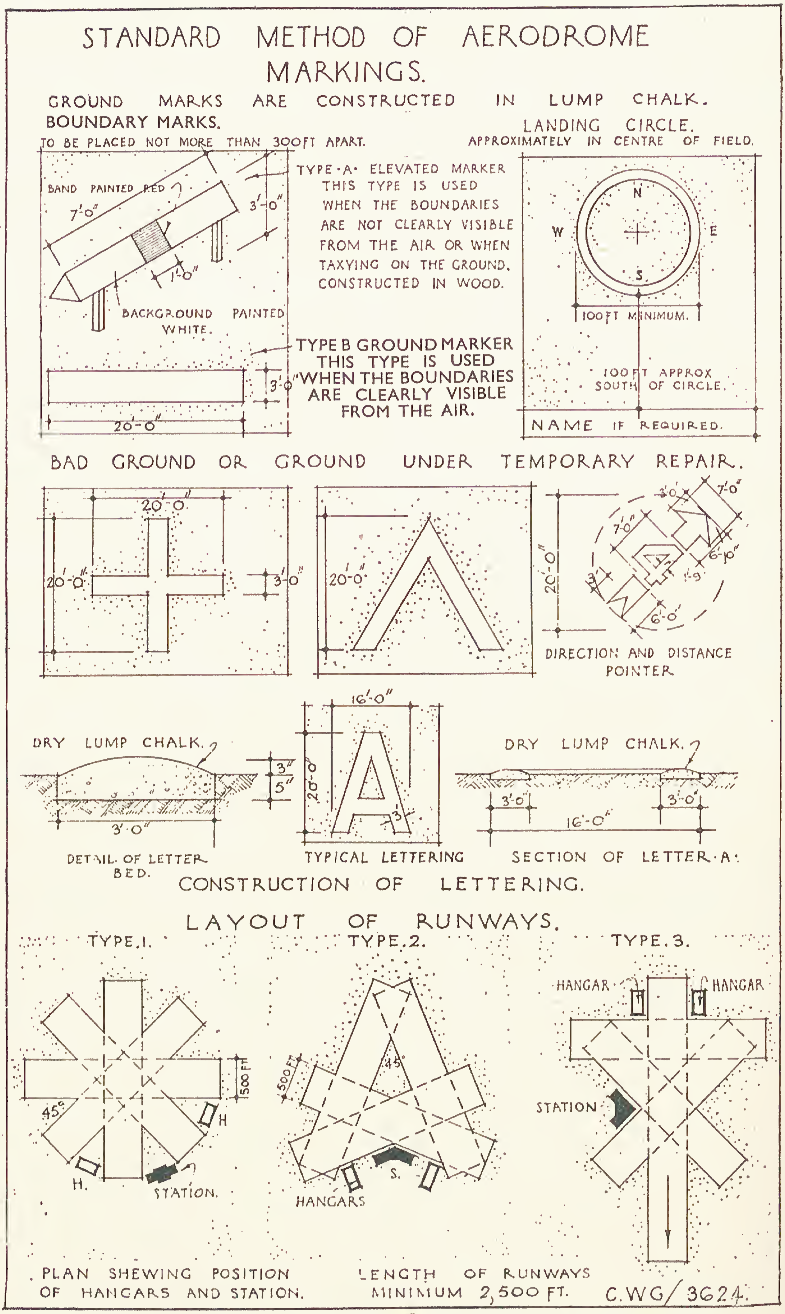


Fig. 5.—STANDARD METHOD OF AERODROME MARKINGS AND LAYOUT OF AERODROMES

The Advantages of Concrete for Runways, Taxying Strips, Aprons, etc.

The advantages of concrete surfacing on aerodromes may be briefly summarised as below :—

(1) The provision of the maximum run-off factor for the paved area largely minimises the cost of drainage.

(2) The taking-off and landing runs for aircraft are minimised owing to the fact that concrete has a high coefficient of friction on the rubber tyres of the aeroplane wheels. The coefficients are as below :—

Wet grass	0·1
Dry grass	0·5
Wet tar macadam	0·5
Dry tar macadam	0·6
Wet or dry concrete	0·7

(3) The concrete surface reduces the risk of stones and dust being thrown up by the propellers.

(4) Impact brought about by irregularities in the surface, normally inseparable from unpaved areas, is removed by the use of properly laid concrete surfaces.

(5) Properly designed concrete surfaces in aerodromes may take the heaviest loads and will provide for the development of machines in the future without danger of disintegration. The largest aeroplanes already weigh over 10 tons each, and there is no limit to the wheel load which concrete may be designed to resist.

(6) The concrete is durable, and the cost of maintenance is a minimum.

(7) The surface texture of the concrete can be made such that it is non-skid in any weather, and small irregularities or corrugations which it may be necessary to employ with this end in view are not serious objections, in view of the universal use of pneumatic tyres on aircraft and the complete disappearance of the tail skid.

(8) The surface can be cambered to give a quick throw-off of surface water, and this should be of the order of 5 in. in 100-ft. width.

Design of Concrete Runways

The following information is extracted by permission from *Concrete in Aerodrome Construction*, a pamphlet issued by The Cement and Concrete Association :—

" Over the last fifteen years wheel loading of the largest aeroplanes has increased from about 4,000 lb. per wheel to something of the order of 15,000 lb. But at the same time tyre sizes have increased, and with a machine of the Hannibal class the tyre area in contact with the ground becomes about 3 sq. ft. per wheel under the landing impact. As intensity of pressure depends on the area of contact, a figure of 2½ tons per sq. ft., including impact on landing, is suggested as the maximum at the present time. At the time of writing the Air Ministry requirements for resistance

of surface and culverts to rolling and impact loads are that the surface shall be strong and firm enough to stand $2\frac{1}{2}$ tons per sq. ft., and any bridge or culvert must stand an impact load of 5 tons per sq. ft. (this figure was previously 3 tons per sq. ft.). These loadings should be regarded as applying as any one square foot of the landing-area.

"It will be appreciated that, as runways are subjected to high-speed rolling and impact loads, their surfacing presents a different problem from that of aprons, which, practically speaking, support only static loads. As with road surfacing, it is the base which carries the load, and the thickness of the concrete surface required to develop the necessary strength depends on the degree of consolidation and freedom from liability to subsequent movement achieved with the base.

"Two general types of slabs are recognised—those with protected corners, and those with unprotected corners. In the former case an edge shear bar or some other suitable device is employed to transmit a portion of the wheel load to the adjacent corner, with resulting reduction in stress. With an unprotected corner no such means is employed, and the corner must be capable of carrying a full wheel load. For prepared ground of known supporting power, and for given static pneumatic tyre wheel loads, and a known impact factor, the formulæ are :—

Protected corners : $$d = \sqrt{\frac{0{\cdot}96\ \mathrm{WI}c}{\mathrm{S}}}$$

Unprotected corners : $$d = \sqrt{\frac{1{\cdot}20\ \mathrm{WI}c}{\mathrm{S}}}$$

where d = Depth of slab of uniform thickness in in.
S = Unit stress in concrete in lb. per sq. in.
W = Static wheel load in lb.
I = Impact factor by which the static load is multiplied to give the total applied load.
c = Coefficient depending on supporting power of the prepared ground.

Values of c are as follows :—

Nature of Ground	*Bearing Power in Lb. per Sq. In.*	*Value of c*
Very soft and plastic	5	1·096
Soft and plastic	10	1·000
Fairly hard	20	0·900
Hard	30	0·842
Very hard	40	0·800
Extremely hard gravel or macadam	50	0·770

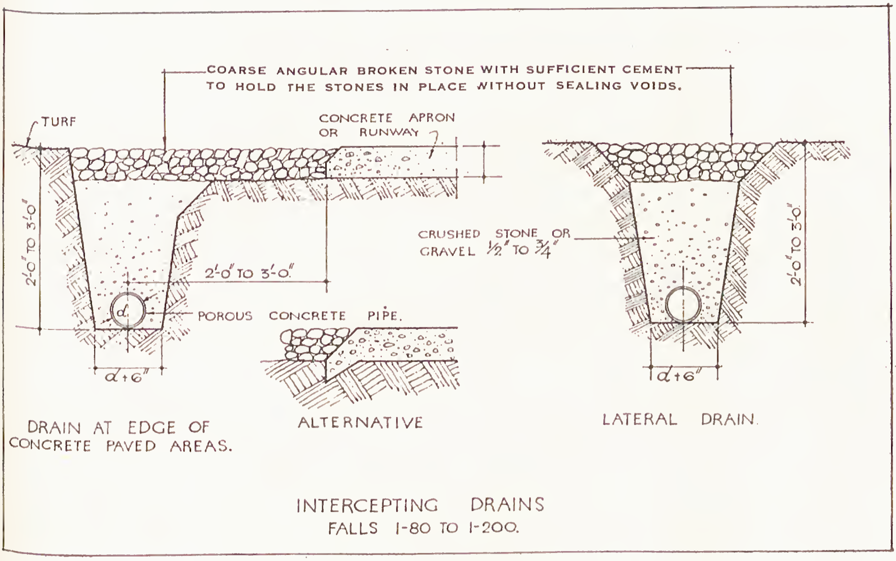


Fig. 6.—Arrangement of subsoil drainage system for aerodrome

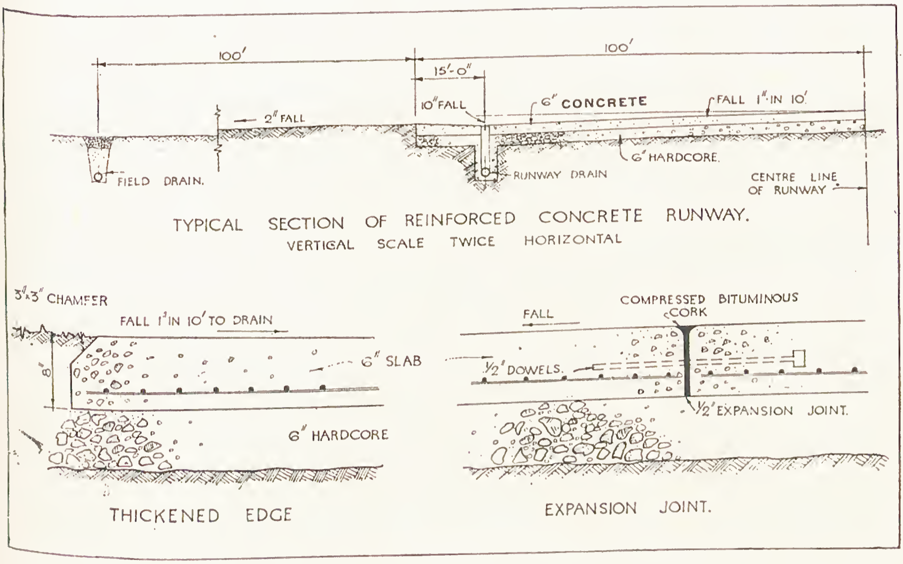


Fig. 7.—Typical section of reinforced-concrete runway

"The maximum intensity of traffic possible on an aerodrome runway is clearly less than on a road. The fatigue factor in the concrete is therefore less, and it is considered that an ample factor of safety is provided by taking S = the Modulus of Rupture divided by 1·6; hence, if the Modulus of Rupture of the concrete is 700 lb. per sq. in., S becomes 437 lb. per sq. in.

"The Impact Factor I is usually taken as 2, for although it may sometimes be higher, bad landings of heavy aeroplanes are not likely to be so frequent as to introduce the factor of fatigue. In America it has been customary to take the value of W as 9,000 lb., but as the loaded weight of a 42-seater Handley Page is close on 30,000 lb., a concrete runway slab of uniform section and protected corners designed for this machine would be worked out as in the following example:—

S = 437 lb. per sq. in.
W = 15,000 lb. (= about $2\frac{1}{4}$ tons per sq. ft. with a tyre contact area of 3 sq. ft.).
I = 2.
c = 1 (corresponding to a bearing power of a little under two-thirds of a ton per sq. ft.);

then the thickness of slab required is:—

$$d = \sqrt{\frac{0{\cdot}96 \times 15{,}000 \times 2 \times 1}{437}}$$
$$= \text{say, } 8 \text{ in.}$$

"An economy in concrete can be achieved by adopting what is known in America as a 'thickened edge' section, in which case the thickness of the middle portion of the slab may be reduced.

"Joint design should conform to concrete road practice. A surface finish which will be skidproof, yet not so harsh as to damage tyres, may be produced by dragging wet sacking over the concrete before it sets. Such a surface is also best from the lighting standpoint: it diffuses the light rays so that the pavement surface is about equally visible from any angle. This property of concrete paving is an important asset, and the advantage is greatest when the surface is neither too rough nor too smooth."

Typical sections of reinforced-concrete runways are shown in Fig. 7, which is based upon successful American practice. These show the dimensions which would normally be employed in a runway 200 ft. wide, and also show the arrangement of the camber, and the drains close to the runway and the surrounding fields. Details of the thickened edge are also shown, together with an arrangement for an expansion joint.

SMALL STREET HOUSE PLANNING AND DESIGN

THERE is no more important unit of architectural design than that of the small house, for the vast majority of people have to live in small houses, and the health of a nation depends very largely upon the manner in which these ordinary dwellings are designed.

The word " designed " used in this context brings one very quickly to a consideration of groups of houses in streets or squares, because the very small house by itself can only with great difficulty attain the dignity of architectural design. It is too small a unit to be set in isolation, it appears socially inadequate ; moreover, it has something in common with the primitive hut. One of the most important developments of architecture occurred when primitive huts were arranged in streets, for the street is the most obvious architectural expression of human sociability. The houses, by touching one another, attain as it were a civic consciousness. It is a mistake to believe that the street belongs only to the large town, for it belongs also to the small village.

The Village Street

When England was predominantly an agricultural country the vast bulk of the population lived in hamlets comprising nothing more than a few streets. Only the large farms were detached buildings, and this was justifiable because they represented small communities of their own, and for practical reasons it was desirable to have an administrative centre for the farm work in the middle of the farm land, but the agricultural labourers would normally live in the village streets. Let us consider, then, the main characteristics of the little house in the village street.

As a rule, we find that the house is entered direct from the street, and has no fore-court or front garden ; nor has it a large back garden. People who are tilling the soil all day long do not feel an urge to attend to a garden in the evenings. There might be a very small back yard and nothing more. The ground floor would be devoted to a rather large kitchen-living-room, while upstairs there would be the bedrooms. This arrangement worked extremely well for several centuries. After all, the main essentials of the small house do not alter very much.

Architectural Possibilities of the Street House

Let us next consider certain special circumstances which give to the street house a quality which the detached or semi-detached house cannot

have. At first sight it would appear that the placing of houses in rows would cause a limitation in the range of design which was attainable under this condition. It may be agreed that there is a limitation in some directions, but we shall find that in other directions there is a great opportunity for expression which the detached house is incapable of achieving. The nature of the restriction is obvious ; the windows can only be at the front and at the back of the house. In saying this one has summed up completely the limitation. The opportunity lies in the much greater variety and architectural dignity which can be achieved in the street formation than in the detached house. If one considers the shape and planning of the main streets in our numerous ancient villages one will not find two alike, whereas to-day, when so many small houses are detached, the general impression we receive of them is that of monotony.

Economy of Material

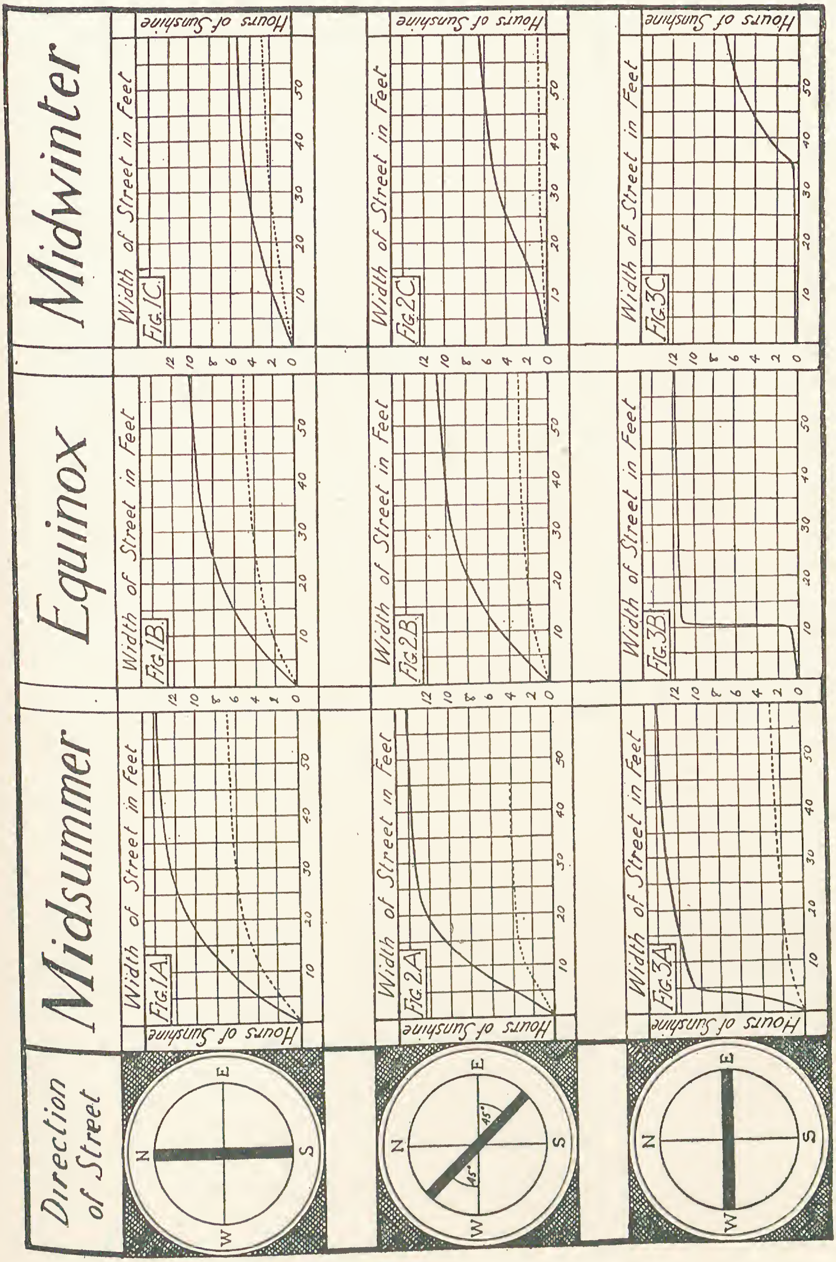
By placing houses in a row there is an obvious economy in material, for each house has only two outside walls instead of four. It is easier to make a street house warm and watertight than it is a detached house. Moreover, this arrangement leads to another economy, inasmuch as the cost of roads and drainage is greatly reduced thereby. Yet up to the nineteenth century we do not find that the design of the small street house was meanly conceived ; the accommodation may have been limited, but the houses do not have the obvious appearance of belonging to what is now called a slum.

The By-law Street

In the industrial period, however, the character of the street house underwent a change. For a variety of causes the population expanded extremely rapidly in less than a hundred years, and the tradition of leisurely building was lost and the housing of the people got into the hands of exploiters whose one ambition was to crowd the greatest number on the smallest space. To remedy this evil the governmental authorities stepped in and made certain regulations for the enforcement of a minimum standard of hygiene. The result of this was what is known as the by-law street. One of the immediate consequences of declaring a minimum standard of accommodation in the house, and a minimum width of street, is that this minimum becomes the maximum, because the value of the land is based on the assumption that there will be crowded on it the largest number of houses permitted by the regulations. If a person put fewer or larger houses on it the ground rent would prove excessive. Let us consider some of the characteristics of this by-law street house, for a good deal may be learnt from the study of it.

Characteristics of the By-law Street House

The speculative builders who erected these houses in enormous quantities did their work, on the whole, well, and displayed considerable



Figs. 1 *to* 3.—GRAPHS FOR FINDING SUNLIGHT OBTAINED IN STREETS

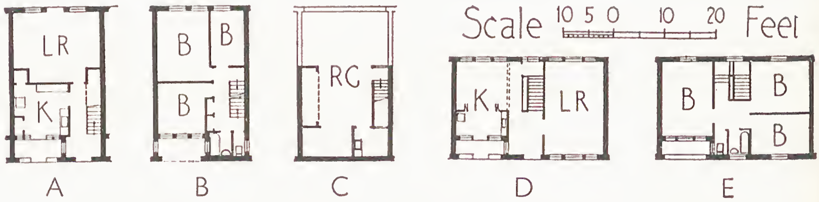


Fig. 4.—PLANS OF STREET HOUSES WITH DOUBLE FRONT ACCESS

A, B, and C show plans of house with narrow frontage. D and E, house with wide frontage.

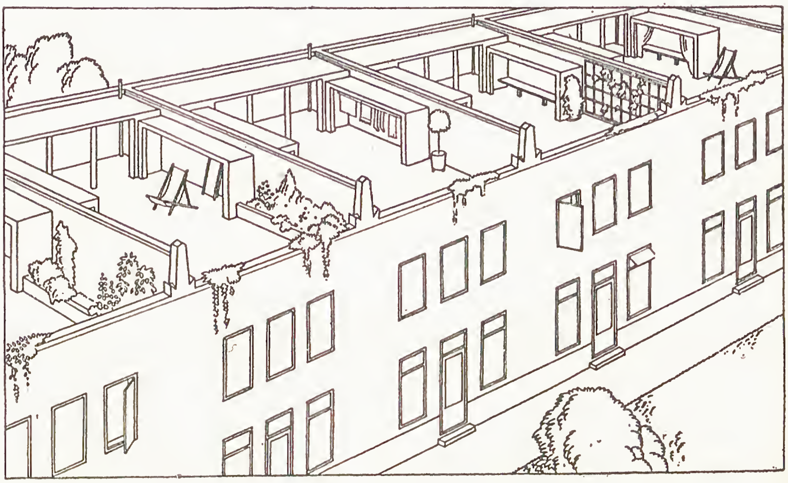


Fig. 5.—ROOF GARDENS

View of roof gardens of houses planned as shown in Fig. 4. Note that the elevation faces the gardens behind the houses.

Fig. 6.—STREET ELEVATION OF TERRACE OF HOUSES PLANNED AS IN FIG. 4

skill in planning, despite the fact that architecturally the houses in question were extremely depressing. The long, monotonous rows did much to bring the very conception of the street into disrepute. A feature which distinguishes the by-law street from that of the eighteenth-century village was the back addition to each house. This results from the attempt to reduce the street frontage to the minimum in order to save road costs. A typical by-law street house had on the ground floor a small parlour, a kitchen-living-room behind, and then beyond that in the back addition a fairly capacious scullery, while on the first floor you would find two bedrooms in the main part of the house and the third bedroom in the back addition. Besides this, there would be a small back yard or sometimes a little garden, while the front door was approached direct from the pavement. Although the appearance of these rows of back additions was extremely mean, from the practical point of view the arrangement had a certain advantage. The little wing at the back of each house served the purpose of a screen which secured complete privacy for the back yard. This is a very important point, for the housewife could emerge from the kitchen and spread the clothes to be dried on the line without being scrutinised by her neighbours. It cannot be said that this advantage is enjoyed by the inhabitants of the garden suburb house of to-day.

It has occurred to the present writer that these back additions might conceivably have been given an architectural quality had they been formally joined up by a series of screen arches or by some other method, and it is a matter for regret that a feature of planning which had something to recommend it on practical grounds should have come and gone without ever having been subject to architectural control. The reason for this was that in the mid-nineteenth century, when these houses were being built in their hundreds of thousands, the dwelling of the working man was not considered a fit subject for the skill of an architect, and he was never called into consultation for the design of it.

Aspect in the By-law Street

In a previous paragraph reference was made to a certain condition of street architecture, namely, that its windows must face either the front or the back. We have seen, however, that the back addition introduces a slight variation inasmuch as certain windows of the back addition are towards the right or left of the building. This point is worth mentioning when one comes to consider the question of aspect. In the by-law street era, and even in the long period preceding it, no attention was paid to aspect in the design of the small street house. It was of common occurrence that the living-rooms on one side faced south, and the living-rooms on the other side faced north, and there was no attempt at all so to plan the houses that the living-room, if it could not face south, could at least

face east or west. Not until the post-War housing developments did this question of aspect receive consideration.

The Semi-detached House and the Return to Street Architecture

The monotony of the by-law street caused a certain revulsion from all streets, with the result that the convention of "open development" was enforced by a regulation forbidding more than twelve houses to be built to the acre. This regulation led to a spate of semi-detached houses which in its general effect was as monotonous as the by-law street itself. By degrees there were introduced blocks of four, blocks of six, and even blocks of ten, and at the present moment there is a tendency to make the number even larger, so that in the not-distant future we may anticipate a return to street architecture even in the small house. If we have a number, even as few as three houses, the centre house has the characteristic of a street house inasmuch as it has neighbours on each side, so there is no need to specify a certain length of the row in order to consider the special conditions which affect the planning of a street house.

Planning the Street House for Adequate Sunlight

The main questions, apart from the general one of internal accommodation, which here need to be discussed are those of aspect in relation to sunlight, access to the front and back doors of the house, and that of garden and recreational space. There are two methods of so planning the house that the main living-room, even when the street faces north, should have adequate sunlight. The first method, and the most obvious one, is to put the living-room at the back, and the kitchen quarters or the parlour (where there is one) in front, on the assumption that the latter rooms are used for a less period of the day than the living-room itself. Another method is to increase the frontage of the house so as to make it possible for the living-room to have windows each end, so that it has sunlight on one side (see Fig. 4, D and E).

Scientific Facts about Sunlight which should influence Layout of Streets

Certain investigations have been made in order to ascertain the minimum distance between the front and the back of the houses if adequate sunlight is to be obtained. At present, for all State-aided housing schemes, this minimum width is fixed at 70 ft. This is based upon the calculation that at noon at the winter solstice the sun is at an angle of 15°, and if we assume that the height of the house is about 20 ft. in a street orientated east to west, on the south side of the houses on the north side of the street there would be just a passing ray of sunshine if no clouds should supervene. It is, of course, a quite arbitrary decree, and takes into consideration only one fact concerning the incidence of sunlight, but it had the great merit in the eyes of the bureaucrats that the rule was easy to administer. Again, as in the case of the by-law street, the minimum

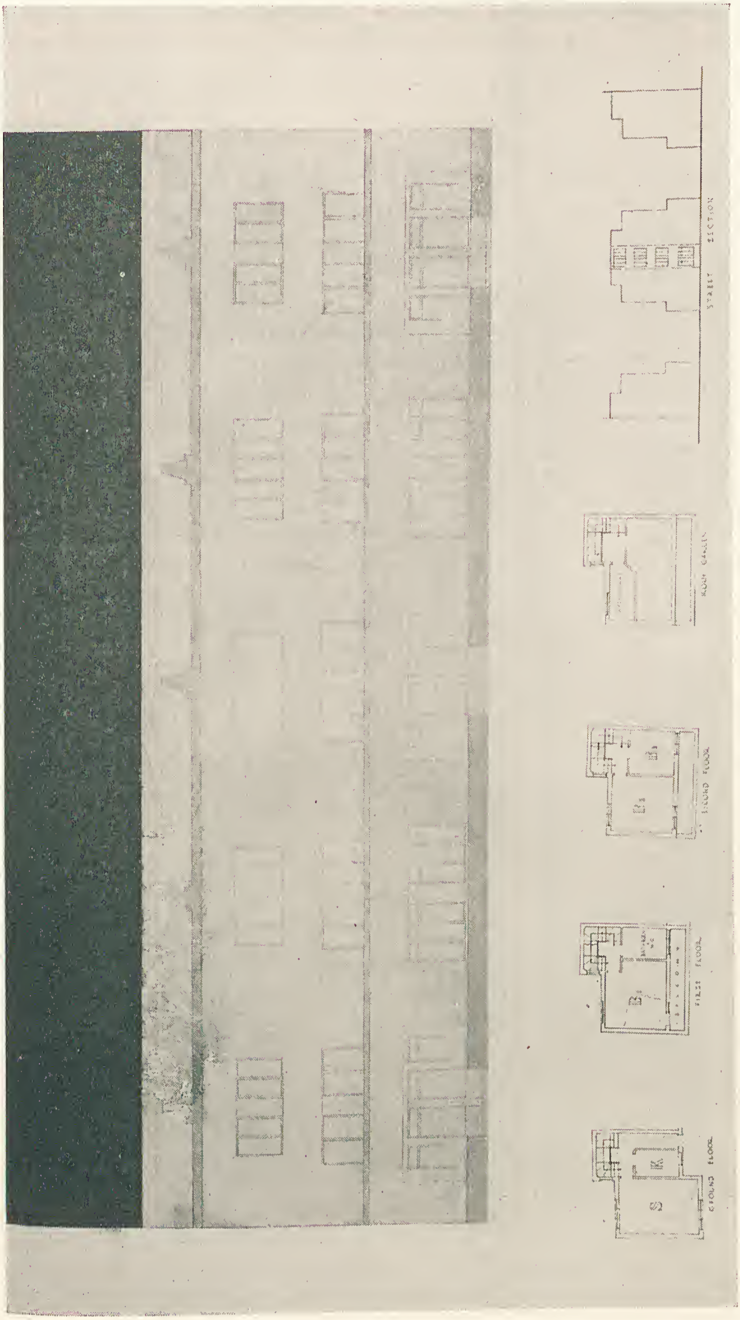


Fig. 7.—FOUR-ROOMED HOUSES WITH ROOF GARDENS—MAXIMUM DENSITY, 60 PER ACRE

Ground floor, sitting-room and kitchen. First floor, bedroom, bathroom and w.c., and balcony. Second floor, two bedrooms. Third floor, roof garden and washhouse.

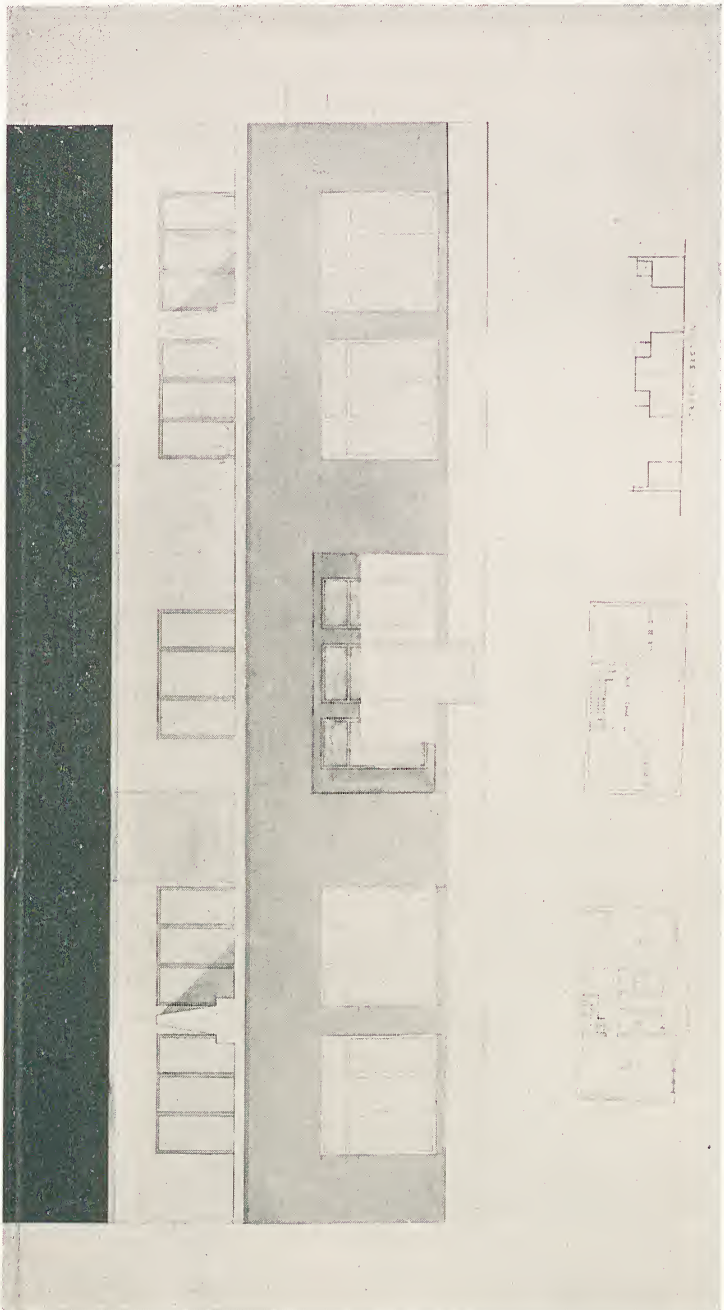


Fig. 8.—FOUR-ROOMED HOUSES WITH ROOF GARDENS—MAXIMUM DENSITY, 45 PER ACRE

Ground floor has living-room, kitchen, bathroom, and bedroom No. 1, while bedrooms Nos. 2 and 3 and roof garden are on the first floor.

width became also the maximum, so there was an undesirable uniformity in the width of all the streets in the Government housing schemes. As the question of sunlight is obviously so important it should be worth while to investigate it more scientifically, and a number of graphs have been got out which give facts about sunlight which should influence the layout of streets (see Figs. 1, 2, and 3).

The Graphs—Explanatory Notes

Explanatory Note No. 1.—The graphs are based upon the positions of the sun in latitude 51½° N. It is assumed that each street is of uniform width and continues indefinitely. The width of the street is taken to be the distance between the buildings as measured from front to front and from back to back, the distance in each case being the same. The street is here described as being in sunshine when the whole of the wall-surface of one side of the street is in sunshine. Hence the total amount of sunshine in the street is equal to the sum of the hours of sunshine on the front and back of each house.

Explanatory Note No. 2.—In the construction of these graphs it has also been assumed that the buildings on either side of the street have flat roofs, and are of a uniform height of 9 ft. Calculations concerning the amount of sunshine in streets of taller buildings can easily be performed, because the amount of sunshine is not dependent upon the actual height of the façade, but upon the ratio of that height to the width of the street.

Example of Use of Graph

In a street where the proportion of width of street to height of building on either side of the street is 4 to 3, how much sunlight would be obtained at midsummer in a street of orientation north to south? *Answer :* In the graph it is assumed that the standard unit of building height is 9 ft., and therefore the width of street with which we are here concerned is 12 ft. If the points of the graph lines immediately above the 12-ft. point in the horizontal ordinate of Fig. 1A are read in relationship with the record of hours of sunlight shown on the vertical ordinate, we find that there would be a total of 8 hours of sunlight equally divided between the fronts and the backs of the houses.

Application of Graph

The graph illustrated points to the possibility of a more reasonable sunlight regulation. The most remarkable result shown by the graph is that given in Fig. 3B. This indicates that at the period of equinox, in the case of streets running east to west, where the proportion of width of street to height of building is 4 to 3, almost the maximum of sunlight is attained, and there is practically no advantage in broadening the street beyond this point. A possible 11 hours' sunlight a day on the façade with south aspect would here be obtained. The sunlight on the façade

with a north aspect is scarcely worth planning for, because the graph shows that even at midsummer it would amount to only three-quarters of an hour.

At the period of the equinox, in the case of streets running north to south a similar proportion of width of street to height of building would give 5 hours' sunlight, equally divided between the fronts and backs of the houses. If this proportion is increased to that of 2 to 1 the duration of sunlight is 7 hours at the equinox and 10 hours at midsummer.

These facts provide sufficient information to enable a sensible and workable sunlight rule to be framed. It must be remembered that for purposes of administration such a rule must not be too complicated.

Planning the Modern Street House for Suitable Access

Another important element of planning the street house is that of access. In the by-law street it was customary to provide, in addition to the street itself, which gave access to the front door, a back road 12 ft. in width, from which the dust was collected and the coal delivered, etc. This was an extremely unsatisfactory arrangement, and costly also. It was not at all pleasant for the housewife to have to go out in the rain, perhaps to the bottom of the garden, to put the refuse in the dust-bin, and fetch the coal to the house. The arrangement was due to the standardised convention that the front of the house must always be devoted to the parlour or sitting-room, no matter what the aspect was, and that the kitchen quarters should be situated at the back. Later on in the article some examples are given of street houses in which this rigid convention has been challenged. The reader will be able to judge of their effectiveness. Meanwhile, however, what means have been developed to solve the problem of suitable access ?

The Semi-basement to give Double Access

When the street house became highly developed for the use of the middle classes, the problem of double access was solved perfectly by the device of the basement. While basements have come in for a good deal of abuse in recent years, what is known as the semi-basement, that is, the basement the ceiling of which is a few feet above ground level, is not only perfectly healthy but very convenient. By this arrangement the secondary access is obtained by a few steps down the area in the front of the house, and the railings around this area perform the very useful function of preventing the ground-floor windows being immediately overlooked by the passer-by. In so many cases it is necessary to go down several feet for the foundations in any case, and so very little extra expense is incurred in having a semi-basement floor. Nine-tenths of the most convenient and beautiful street houses of the eighteenth century had this feature, and one finds also that quite small houses for the wage-earners were designed on the same principle. One may confidently

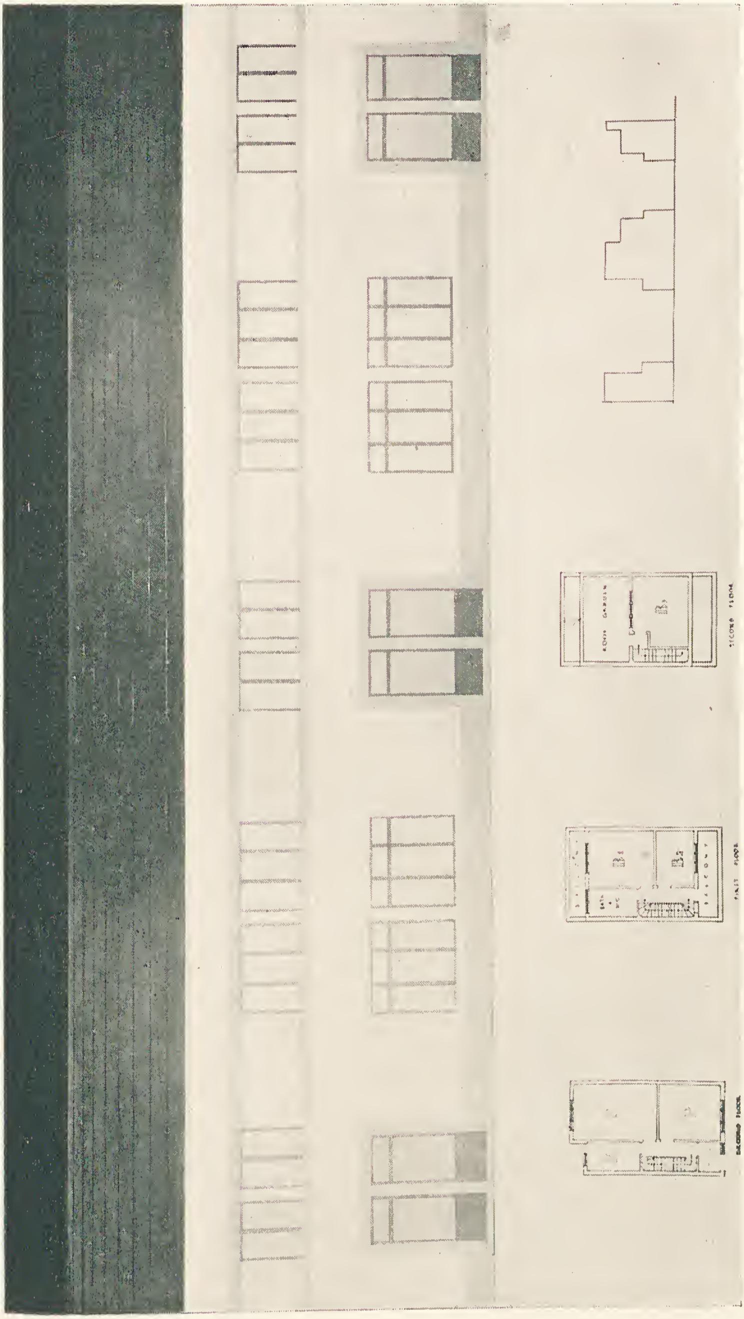


Fig. 9.—FIVE-ROOMED HOUSES WITH ROOF GARDENS—MAXIMUM DENSITY, 45 PER ACRE

Ground floor, hall, kitchen, and two rooms. First floor, two bedrooms, two balconies, and bath and w.c. Second floor, one bedroom and roof garden.

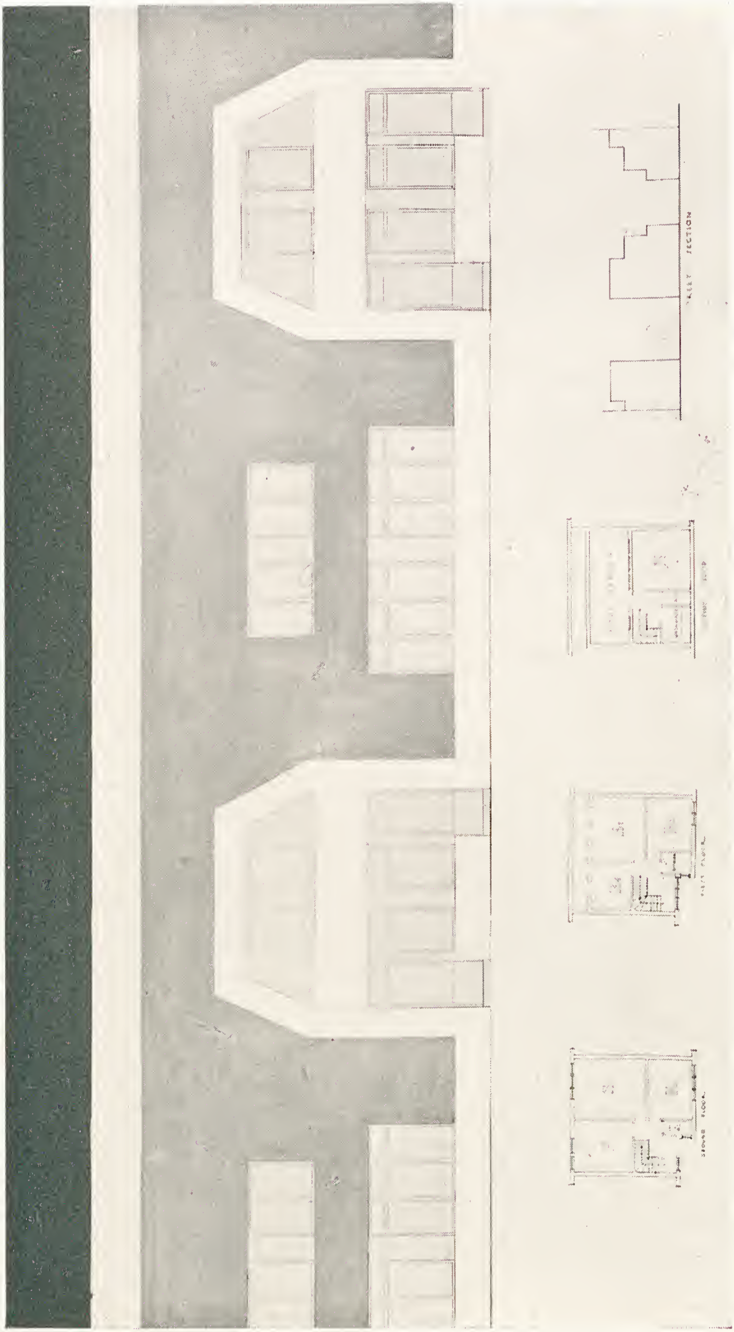


Fig. 10.—SIX-ROOMED HOUSES WITH ROOF GARDENS—MAXIMUM DENSITY, 40 PER ACRE

Ground floor, two rooms, kitchen, and lavatory and w.c. First floor, three bedrooms, bathroom, and balcony. Second floor, roof garden, washhouse, w.c., and nursery.

anticipate that at some future date, when street architecture once more comes into its own, the semi-basement will be revived.

The Back Door and Internal-tunnel Methods of Double Access

But the semi-basement is by no means the only solution to the problem of double access to a house. In the case of the detached or semi-detached house the problem is, of course, solved very easily by having the "back door" at the side. In the groups of four or six cottages which were built under the post-War housing schemes they evolved the device of the internal tunnel, which went through the block to the back garden, giving access to the back doors of the houses on either side of it. But this was not a very satisfactory arrangement, because these tunnels were apt to be improperly used by strangers.

Planning with Double Access from Front on Ground Level

If we rule out the basement, the back road, and this type of tunnel, there is only one other solution, namely, double access from the front on the ground level. This method has not as yet been very largely employed, yet it offers very great possibilities for a new and convenient type of street architecture. Where the street faces north, west, or east, this arrangement may be effected on quite a narrow street frontage, because the front entrance can lead to a hall with staircase and a passage giving access to the living-room at the back of the house, and a separate door can lead to the kitchen in the front of the house, while the dust-bin can be placed in a recess.

The plans, Fig. 4, illustrate this arrangement, and Fig. 6 shows the street elevation of a terrace of houses designed in this manner. It will be observed that a roof garden has here been provided. This new type of street house, with recesses and roof gardens, first appeared in a publication, *A Hundred New Towns for Britain*, one section of which is especially devoted to exploring the possibilities of arriving at a happy mean between tall tenement blocks on the one hand and the method of open development of cottages at a minimum of twelve to the acre on the other. Whether it is possible to design houses at a considerably higher density than that now permitted by the by-laws is an interesting architectural problem.

Use of the Roof Garden

The roof garden, which provides additional recreational space for each house, is certainly a new factor which may be held to justify an increase in the density of houses per acre. We therefore illustrate one type of new house which combines the recess already mentioned and the roof garden (Figs. 5 and 6). In the example given the recesses are arranged in pairs. There are two small gateways in each recess, leading to the "back doors" of the houses. Here the conventional term "back door" is still used, although in point of fact they are situated

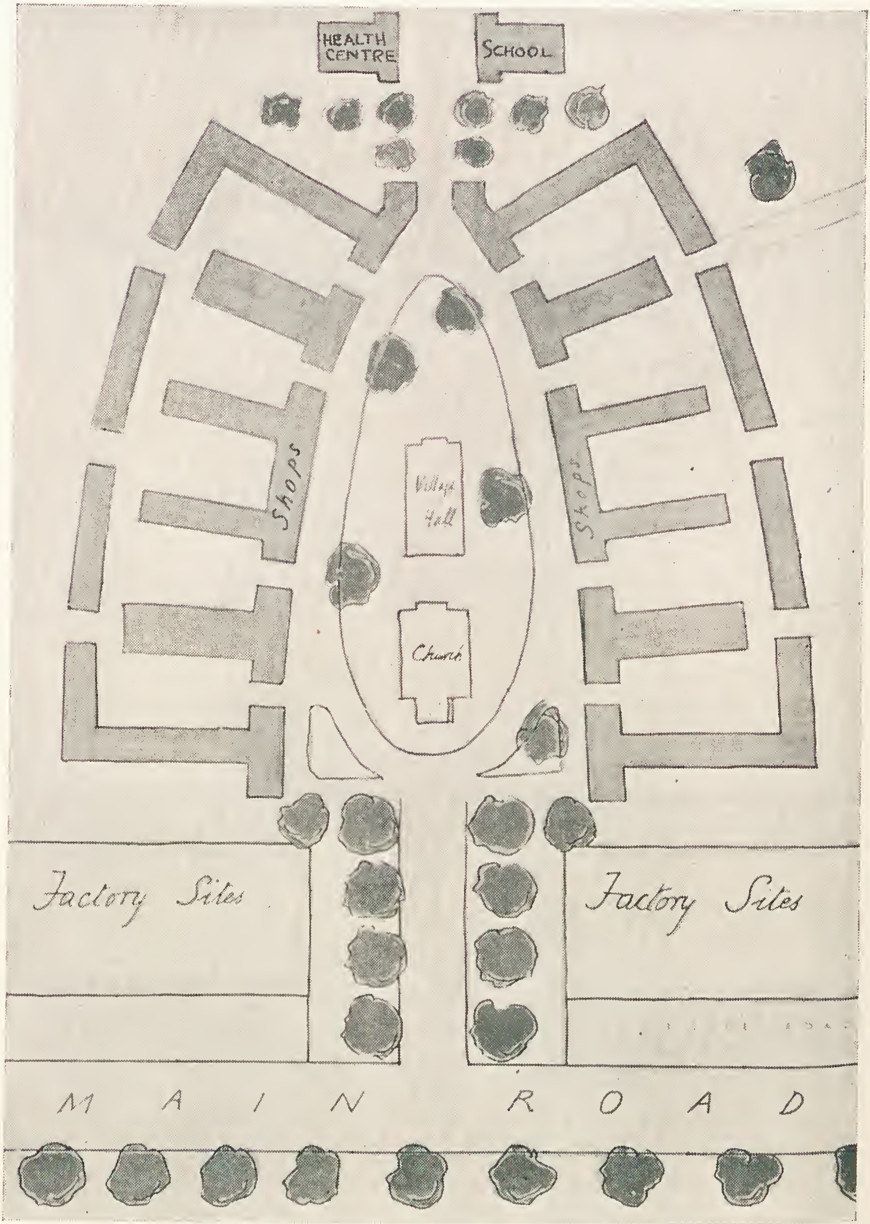


Fig. 11.—A POSSIBLE GROUP OF ABOUT 200 HOUSES ARRANGED IN COURTS GIVING ACCESS TO A VILLAGE GREEN

This is an alternative to the method of " open development " now commonly adopted in new housing estates.

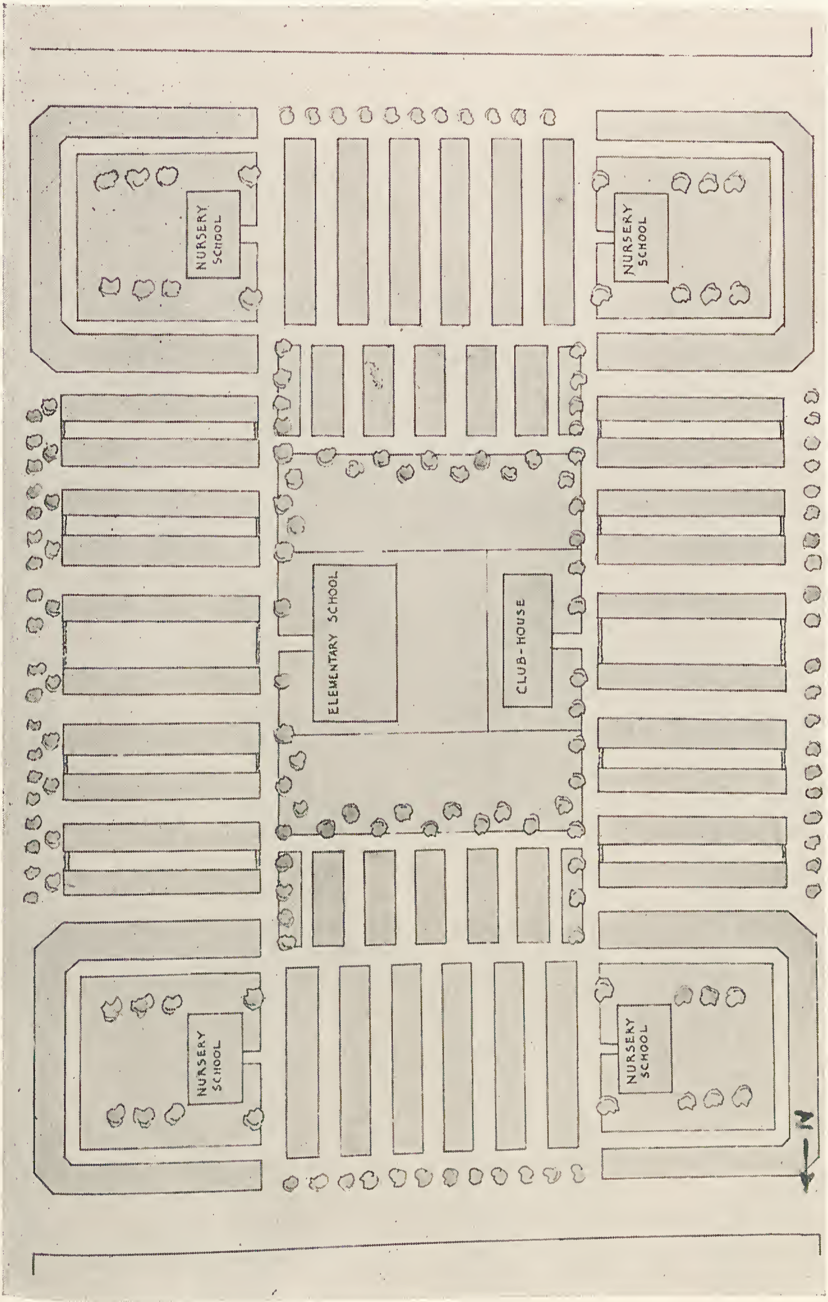


Fig. 12.—SUGGESTION FOR REDEVELOPMENT OF 25 ACRES ON SITE WHERE EXISTING SLUMS HAVE BEEN DEMOLISHED

Gross density of houses in area, 30 to the acre.

in the front of the house. The dust-bins, hidden from view by the low screen walls, are at the corners of the recesses, and there is also room for coal-bins should these be required. The low screen wall serves the purpose, too, of keeping the passer-by a little distance away from the kitchen windows.

Ideas for the Roof Garden

Fig. 5 is a perspective view of the roof gardens of these same houses. It is important to note that this elevation is not towards the street, which contains the front and " back " doors, but it faces the garden behind the houses, and the doors on ground level belong to the living-rooms and give access from the latter to the open space, which can either be laid out as a common recreational ground, as here shown, or be divided into separate garden plots. The system of planning here exemplified is primarily designed for houses heated by a hot-water system or else by gas or electricity. On the other hand, where coal fires must be employed, chimneys against the party walls, taken up above the screen walls dividing the gardens, would not necessarily be objectionable. In the roof garden as here planned a sink is provided so that part of the small enclosure may, on occasion, be used as a washhouse.

The screen walls of the roof garden are 8 ft. high. The garden can only be overlooked by the occupants of the roof garden on the other side of the court, but, if necessary, for the benefit of sun-bathers, a screen could be stretched across part of the space. Needless to say, the roof garden could be used for drying clothes. Another function it can perform is to provide an open-air nursery under conditions where the maximum of sunlight can be obtained, and not only young children but other members of the family might derive great benefit from the practice of sleeping in the open on the roof garden when weather permits.

Gardens at Back of Houses

The policy here recommended is also to arrange the layout so that the maximum amount of garden is at the rear of the houses, where those who use the recreational space are protected from the noise and dust of the street traffic. Glazed doors in the sitting-rooms at the back of the houses give access to the garden, which can also be approached by cross-roads at the end of the terrace should this be necessary for any purpose. The plan showing the arrangement here illustrated represents the very maximum economy in draining costs. In existing towns, where land is very expensive, it is an extravagance to waste it in forecourts which provide no privacy and in consequence are little used by the occupants of the houses, or in very wide roads with grass verges which do not really constitute recreational space. There is much to be said for keeping the streets to the minimum width which would ensure the provision of adequate sunlight.

MODERN EXAMPLES OF HOUSE PLANNING AND DESIGN

HOUSE AT EDGBASTON

Fig. 1.—A MODERN HOUSE IN HARMONY WITH " GEORGIAN " SURROUNDINGS
House at Edgbaston. (*Architect : Francis W. B. Yorke, F.R.I.B.A.*)

THIS house was designed to be in keeping with its neighbours on the Edgbaston Estate, where there still remain many fine examples of early-nineteenth-century stucco work. The front door is protected by a glazed canopy carried on a semicircular channel, and the forecourt is laid out as a Dutch garden with a painted and gilded wall sundial in Campden stone.

Eleven-inch cavity walls, rendered ; slate roof. Cost of house £3,000, including garden work.

Finishes

The rendering is putty colour, carried out in horizontal lifts of approximately 3 ft. per day, to avoid streakiness ; the gates, woodwork generally, and steel casements are painted a light shade of green.

Walls finished internally with a wood float for distemper ; hardwood flush doors ; staircase balustrade plastered over mesh and brick lathing and capped with an oak handrail.

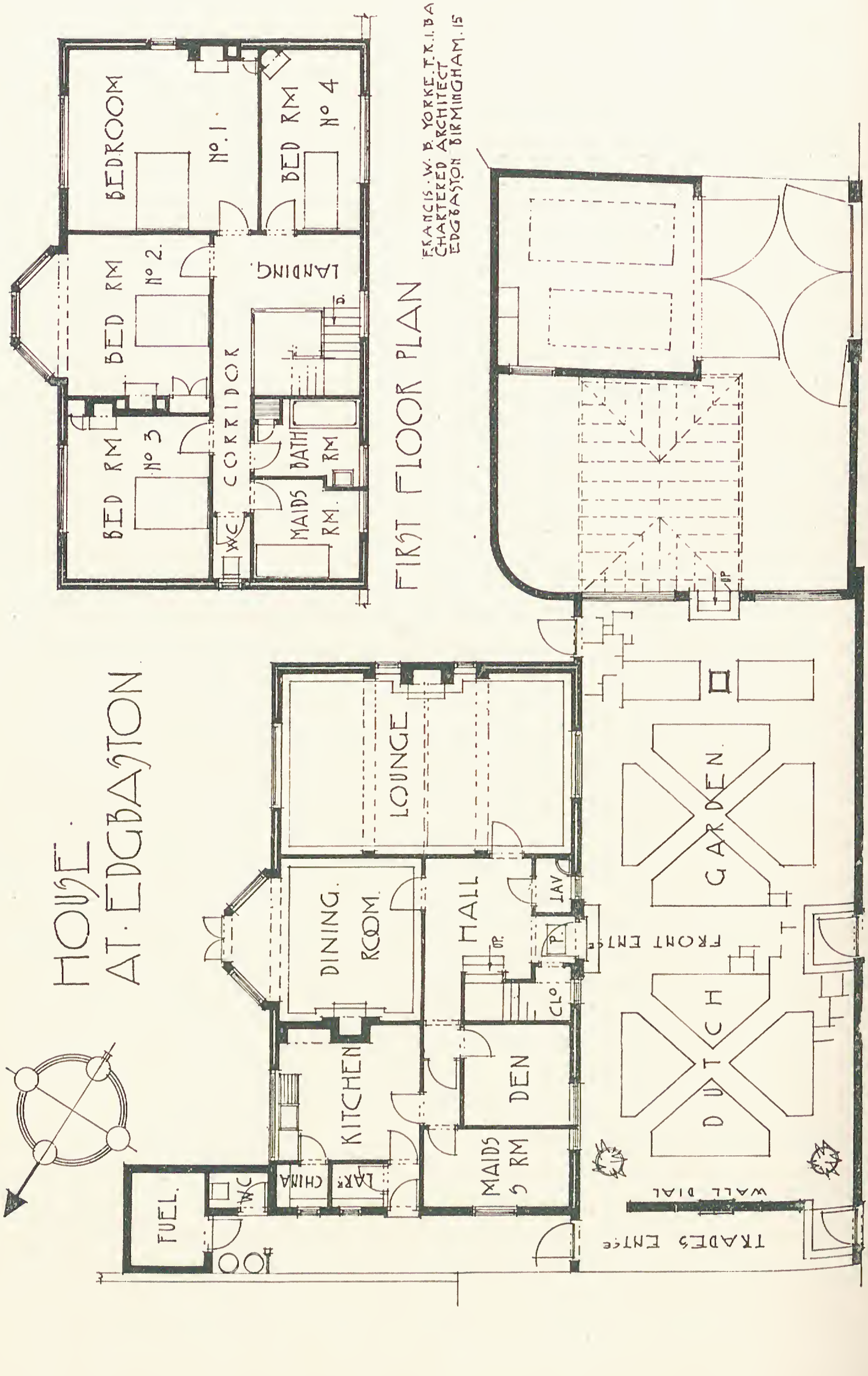


Fig. 2.—GROUND-FLOOR AND FIRST-FLOOR PLANS—HOUSE AT EDGBASTON

HOUSE AT SOLIHULL, WARWICKSHIRE

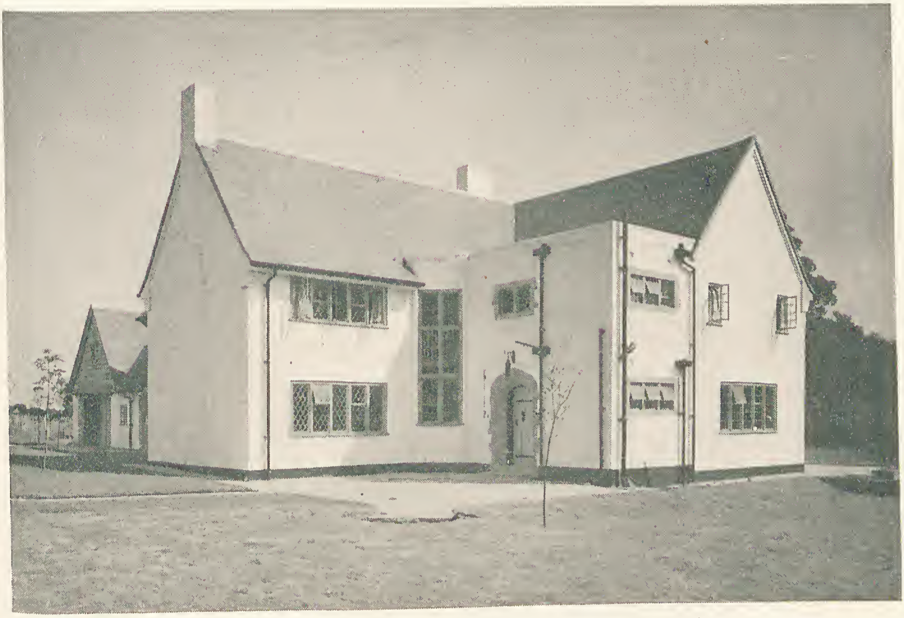


Fig. 3.—BUILT IN LOCAL TRADITION—HOUSE AT SOLIHULL, WARWICKSHIRE
(*Architect : Francis W. B. Yorke, F.R.I.B.A.*)

A house in Warwickshire, with no pretensions to style, but built on lines of local tradition, planned to serve its purpose as a professional man's home with every modern convenience, convenient service, and to take every advantage of the sun. The breakfast-dining-room, for instance, has windows east and west.

Materials

The fireplaces are all built up of brick, tiles, or stone, and the ceilings to principal rooms are oak-beamed. The staircase has a solid balustrade of "Brickaniron," surmounted by oak handrail. The elevations are of local brick, cream coloured, and the external woodwork is painted blue.

The pitched roofs are of hand-made tiles, and the stone dressings of Guiting stone.

Plans

See Fig. 4. The lounge is spacious, with ingle, and the dining-room is conveniently placed for services from the kitchen. The wash-up is provided with sliding doors for access during work hours. The principal bedroom has open timber roof, and ingle, and a separate bath and lavatory suite.

The garden has been designed with the house, and slopes towards

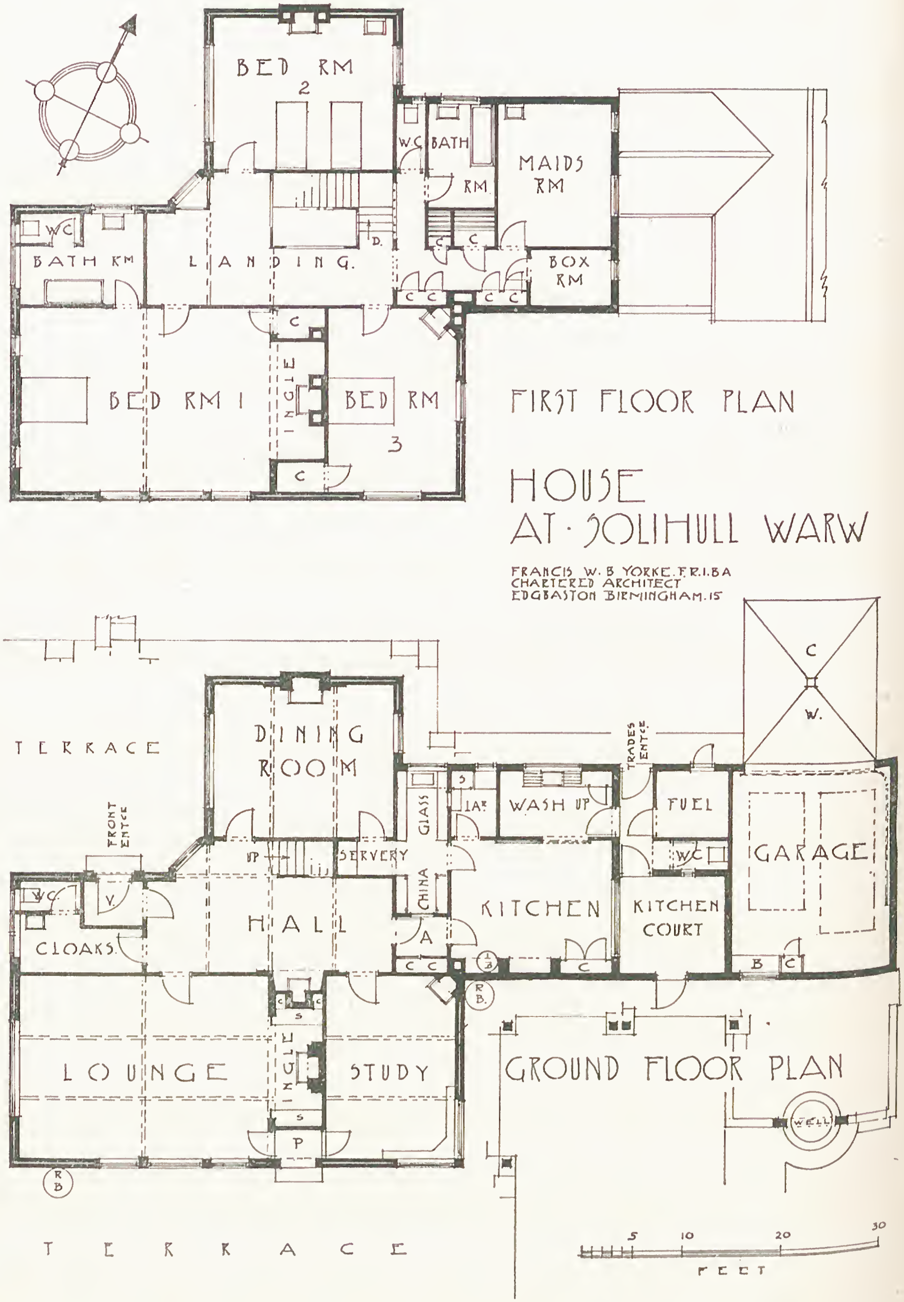


Fig. 4.—Ground- and first-floor plans of house at Solihull, Warwickshire

extensive woodland. A coppice on the site has been preserved, and planted with wild flowers. Direct access to garden is provided from lounge and study.

The house is heated by low-pressure hot water.

The total contract, including fittings, was £3,500.

HOUSE AT HAGLEY, NEAR STOURBRIDGE

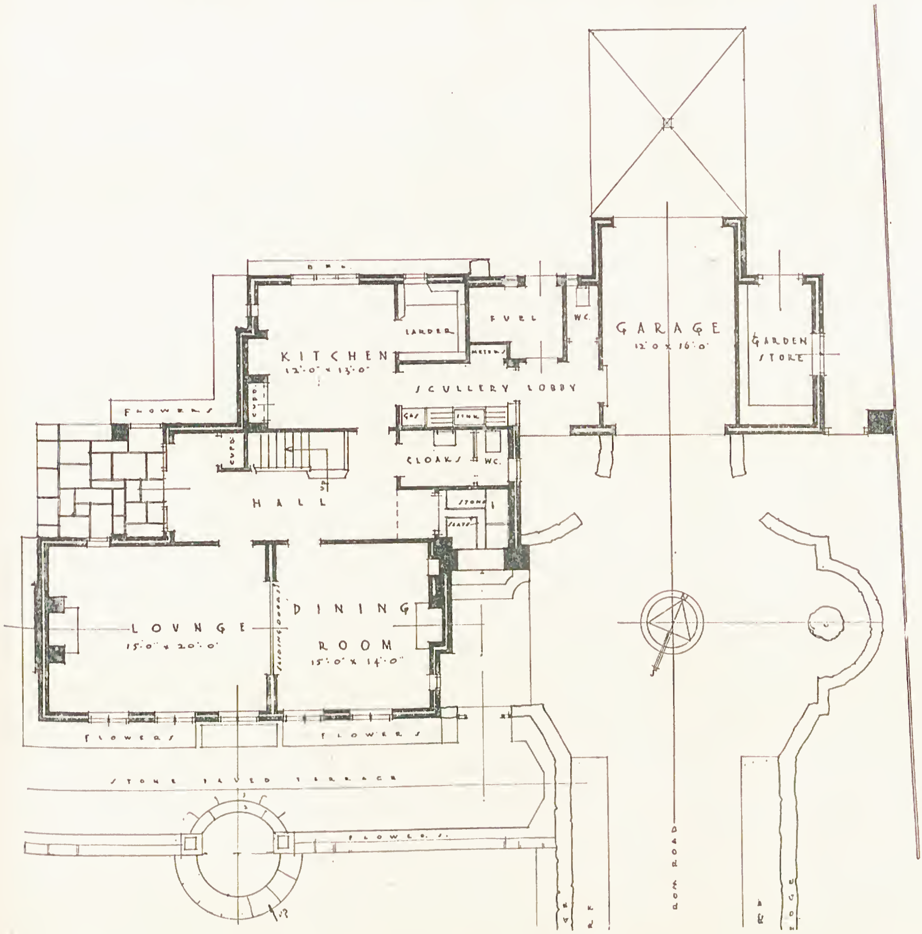


Fig. 5.—HOUSE AT HAGLEY, NEAR STOURBRIDGE, WORCESTERSHIRE—GROUND FLOOR (*Architects: Folkes & Folkes, F/A.R.I.B.A.*)

A house in the traditional manner, built of $2\frac{1}{4}$-in. rustic bricks, with hand-made sand-faced tiles, and standard metal windows in wood frames. See Figs. 5, 6, and 7.

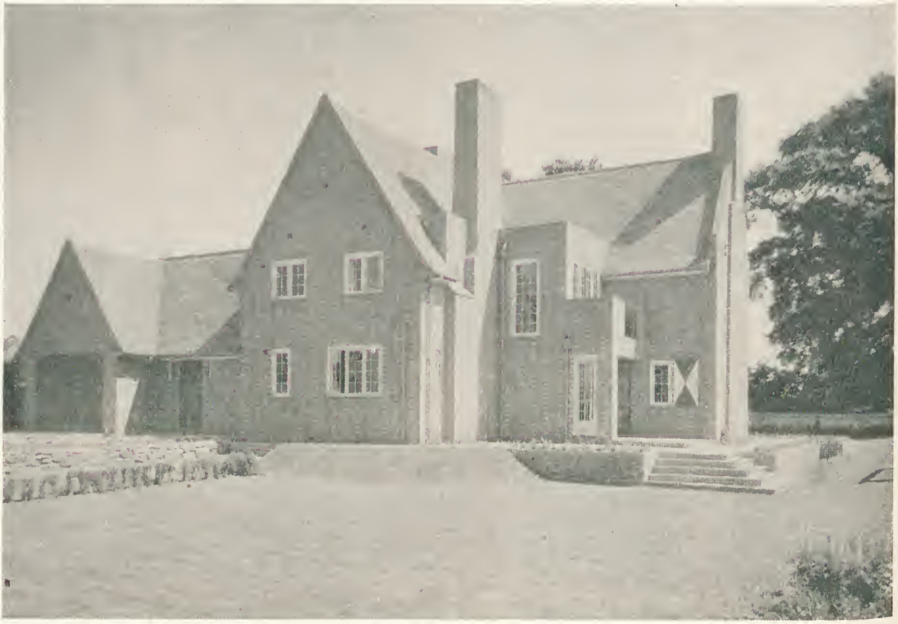


Fig. 6.—HOUSE AT HAGLEY, NEAR STOURBRIDGE, WORCESTERSHIRE, LOOKING FROM NORTH-WEST

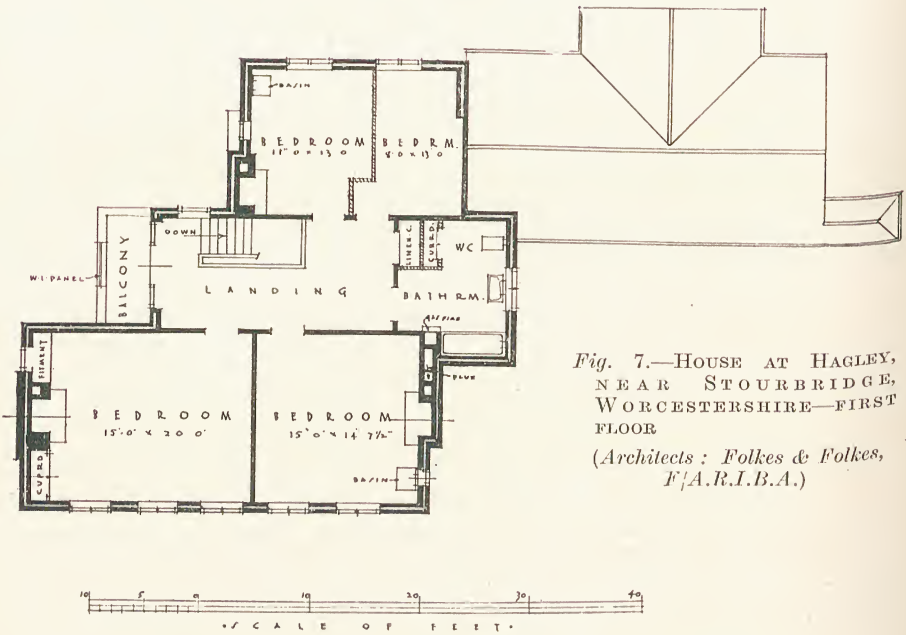
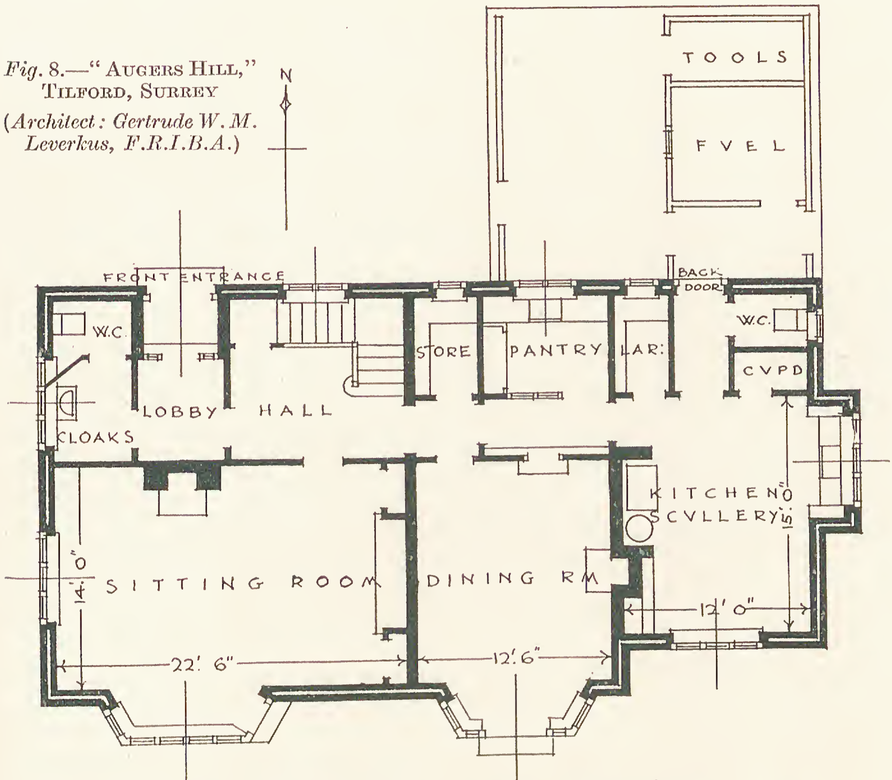


Fig. 7.—HOUSE AT HAGLEY, NEAR STOURBRIDGE, WORCESTERSHIRE—FIRST FLOOR

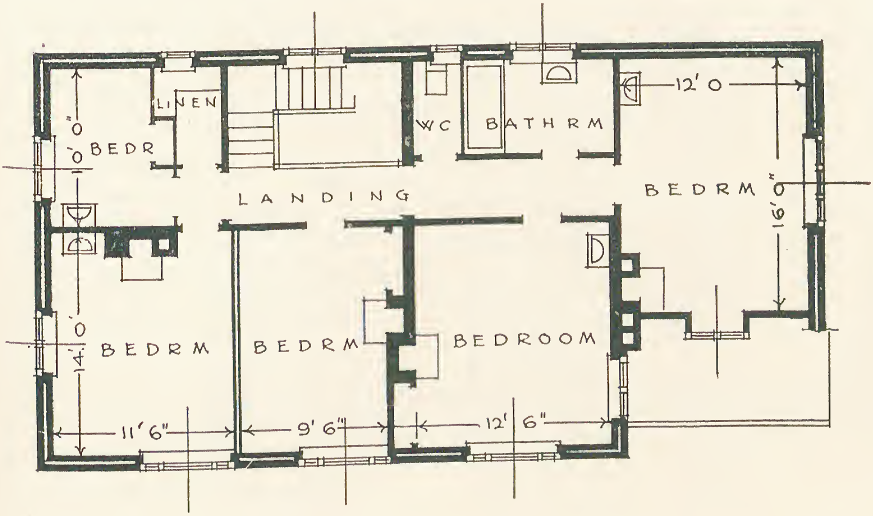
(*Architects : Folkes & Folkes, F/A.R.I.B.A.*)

Fig. 8.—" AUGERS HILL," TILFORD, SURREY

(*Architect: Gertrude W. M. Leverkus, F.R.I.B.A.*)



GROVND FLOOR



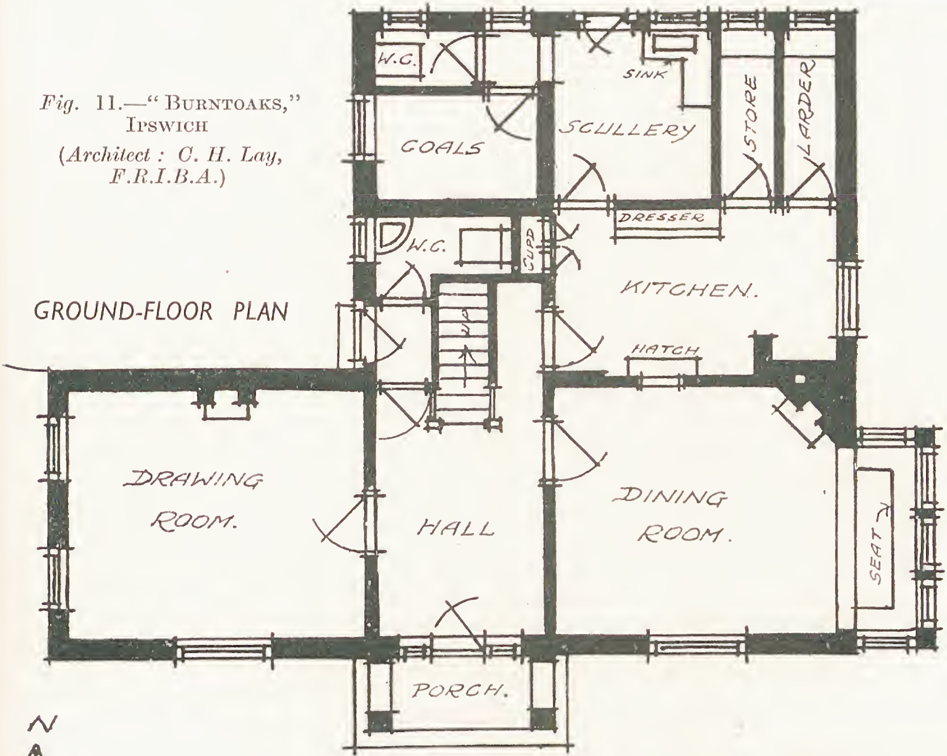
FIRST FLOOR

Fig. 9.—"AUGERS HILL," TILFORD, SURREY
See plans, Fig. 8. (*Architect : Gertrude W. M. Leverkus, F.R.I.B.A.*)

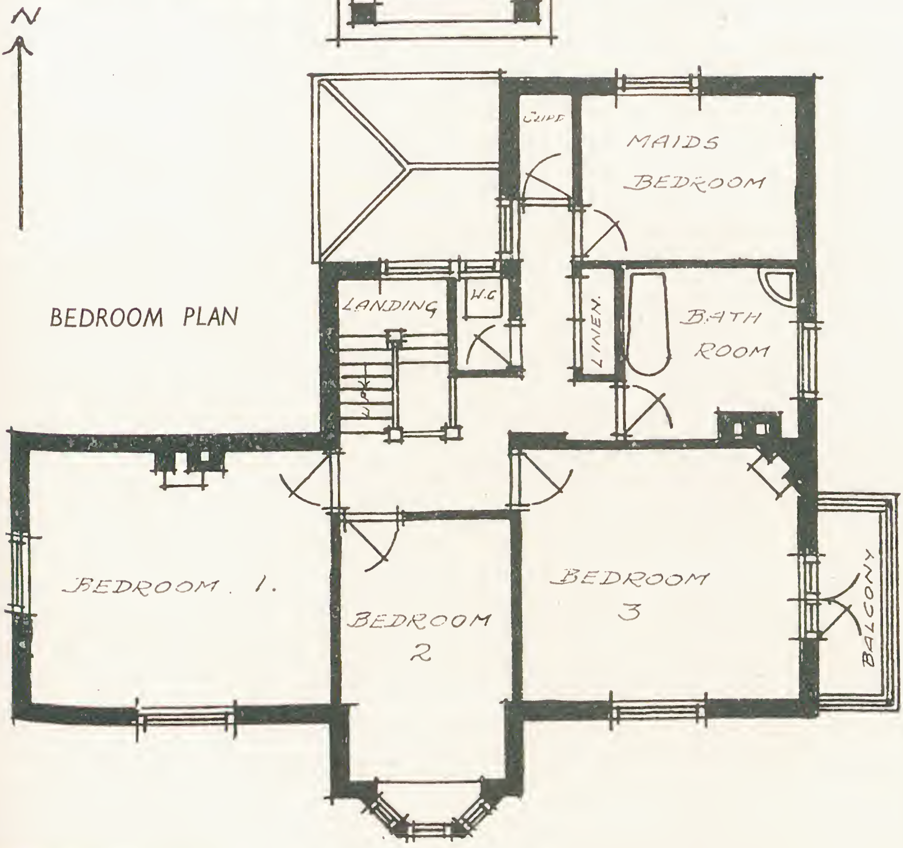
Fig. 10.—"BURNTOAKS," IPSWICH
See plans, Fig. 11. Walls—stucco. Dressings—red brick. Tiles—green pantiles.
(*Architect : C. H. Lay, F.R.I.B.A.*)

Fig. 11.—" BURNTOAKS," IPSWICH (*Architect : C. H. Lay, F.R.I.B.A.*)

GROUND-FLOOR PLAN



BEDROOM PLAN



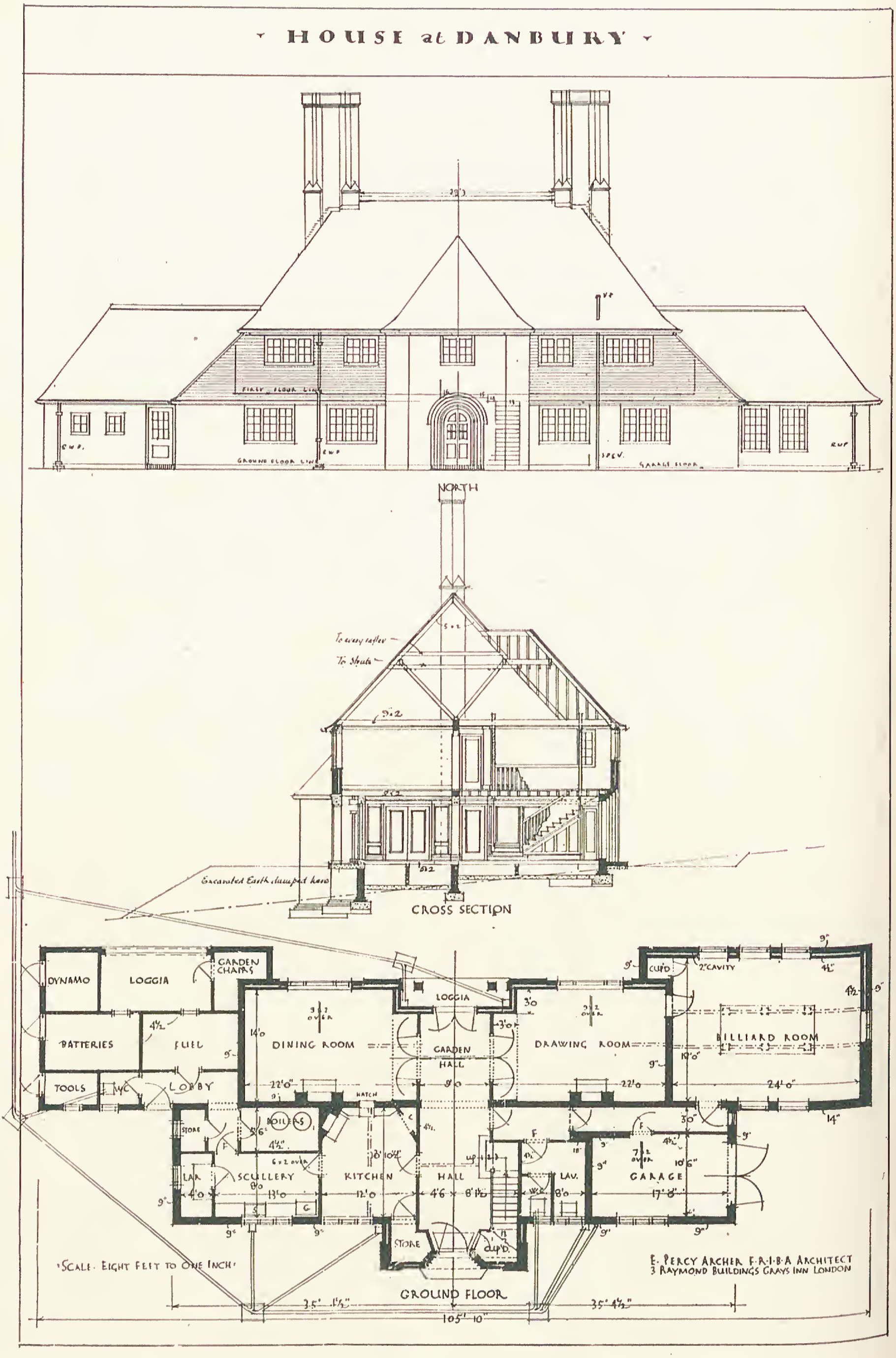


Fig. 12.—NORTH ELEVATION, CROSS-SECTION, AND GROUND-FLOOR PLAN

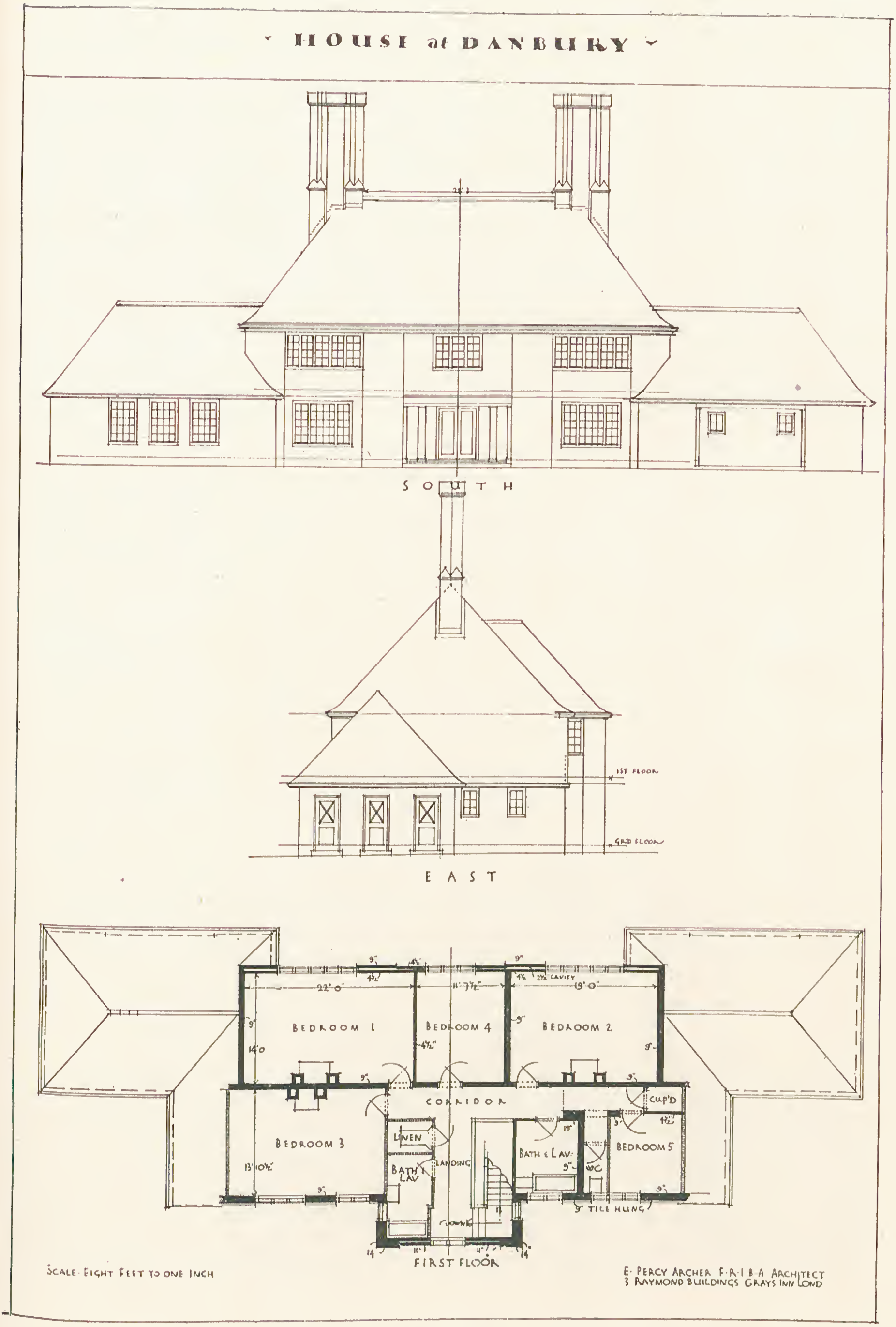


Fig. 13.—South and east elevations, and first-floor plan

HOUSE AT DANBURY

This house (Figs. 12 and 13) stands on a 3-acre plot, which is a bite out of Danbury Common, Essex.

Structure

The site slopes away somewhat sharply to the south, and in consequence it was found more practicable to form the terrace as a reinforced-concrete platform covered with York-stone flag paving.

The walls, which are of a pleasant-coloured red sand-faced brick, lime pointed, were built hollow, with a 9-in. outer skin, the bond being English. Old roofing tiles were obtained from an old barn on Osea Island, in the Blackwater Estuary.

Finish

The walls of the dining-room, hall, and billiard room are panelled in Japanese oak. The drawing-room is panelled in plaster.

There are lavatory basins in all bedrooms, with cupboards under ; the wastes from these do not appear on the elevation, being carried down in the re-entrant angles of the central loggia.

The house is centrally heated. There is a telephone room under the staircase.

HOUSE AT DUMFRIES

Copyright, James C. Gair

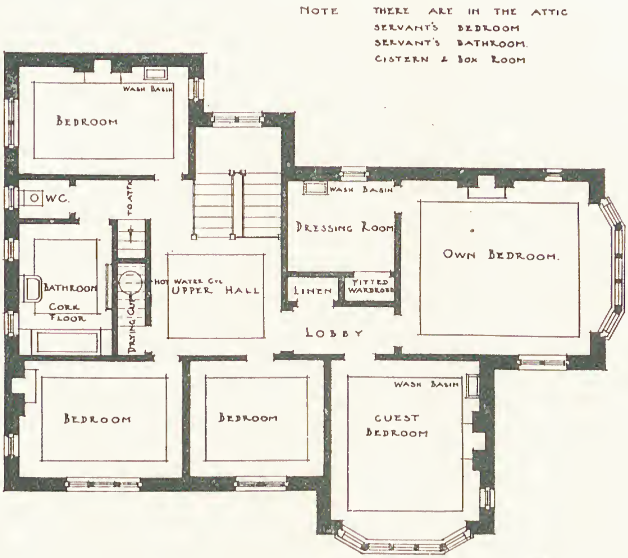
Fig. 14.—HOUSE AT DUMFRIES
(*Architect : J. McLintock Bowie, F.R.I.B.A.*)

The house occupies an elevated site on the outskirts of Dumfries, commanding extensive views of the surrounding district; the aspect is south.

Materials

The base of the walls, the door-piece, and chimney heads are of local multi-coloured bricks. The upper part of the walls is covered with "Snowcrete" trowelled to a very rough surface. The breasts of the oriels and the roofs are covered with cherry-red tiles.

The ground floors are solid, finished on top with pumice-breeze concrete, a layer of $\frac{1}{4}$-in.-thick bitumen, a rough pine flooring laid diagonally, and $\frac{1}{2}$-in. polished oak parquet. The walls of the entrance porch are wood-panelled.



FIRST FLOOR PLAN

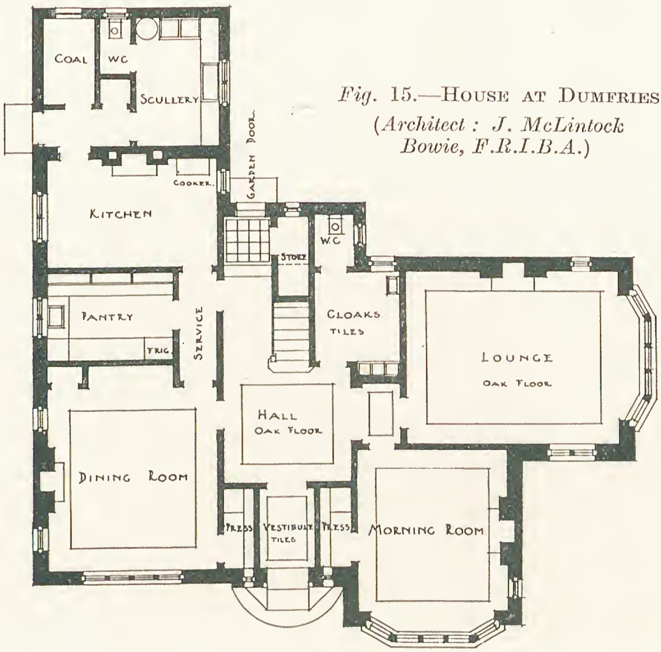


Fig. 15.—HOUSE AT DUMFRIES
(*Architect: J. McLintock Bowie, F.R.I.B.A.*)

GROUND FLOOR PLAN

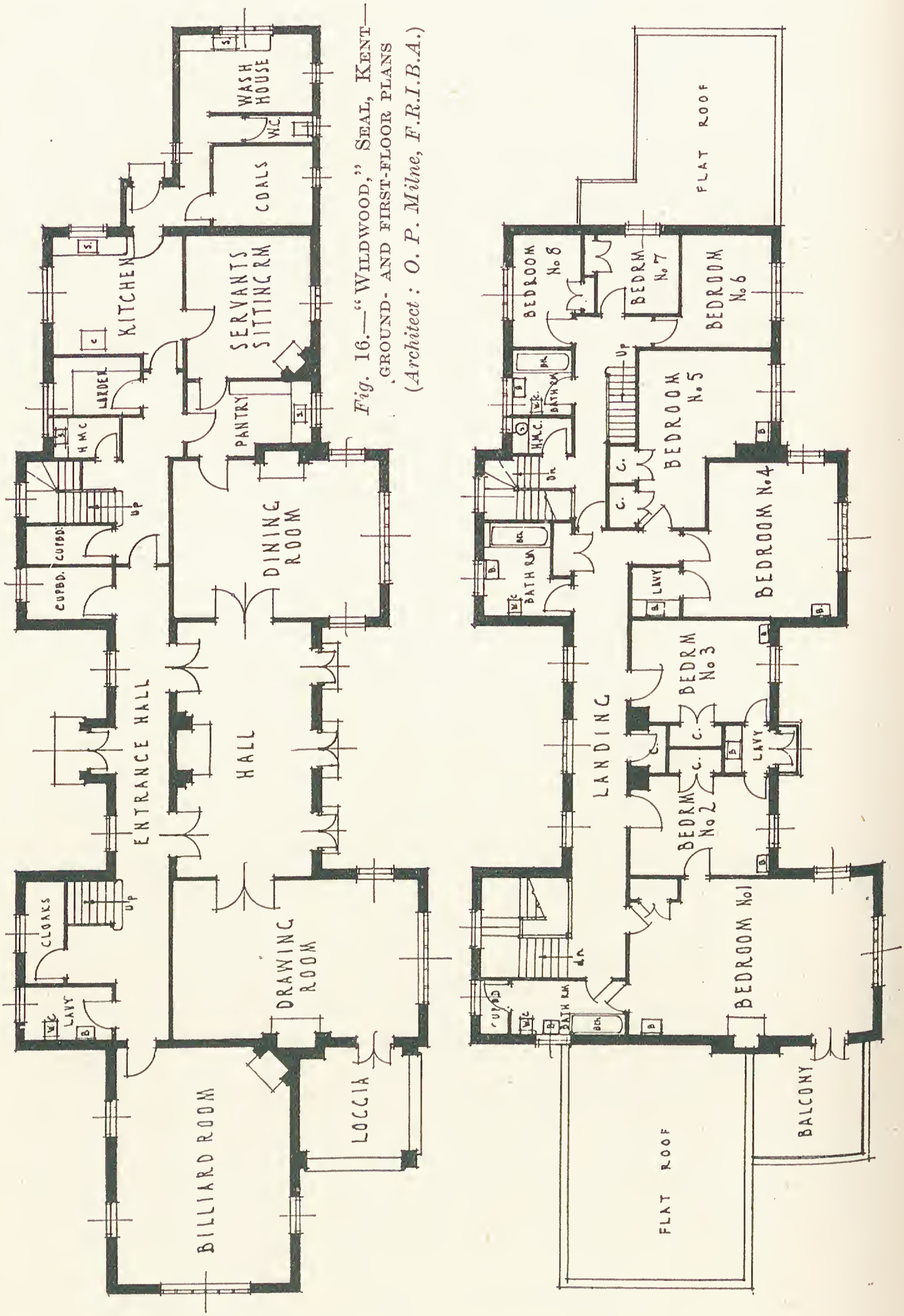


Fig. 16.—"WILDWOOD," SEAL, KENT—GROUND- AND FIRST-FLOOR PLANS (*Architect: O. P. Milne, F.R.I.B.A.*)

Fig. 17.—"WILDWOOD," SEAL, KENT

Country house built on a steeply sloping site below a wood. The entrance drive descends through the wood to the north side of the house. The living-rooms all look out to the south, over the garden, and command fine views. Built of hand-made brick, varied in colour. Roofs, English pantiles.

House follows English traditions of building, and its simple composition fits well with the English countryside. Modern ideas of open-air living are met by the wide loggia and the balcony over it. The sloping site has been turned to account, the terracing and flights of steps making an attractive setting. (See Fig. 16.) (*Architect: Oswald P. Milne, F.R.I.B.A.*)

Fig. 18.—"LAUDER HA'," STRATHAVEN, LANARKSHIRE, FOR SIR HARRY LAUDER

House constructed of whin, with stone dressings and slated roofs. Style adopted is that of domestic work characteristic of the seventeenth century in Scotland. Open site with southerly aspect. A special feature of the plan (Fig. 19) is the curio room for the display of the owner's large collection of interesting souvenirs, gifts, and curiosities from all parts of the world in which he has travelled. Cost, including garage and caretaker's house, with grounds and enclosures, was £13,000. (*Architects: Cullen, Lochhead & Brown.*)

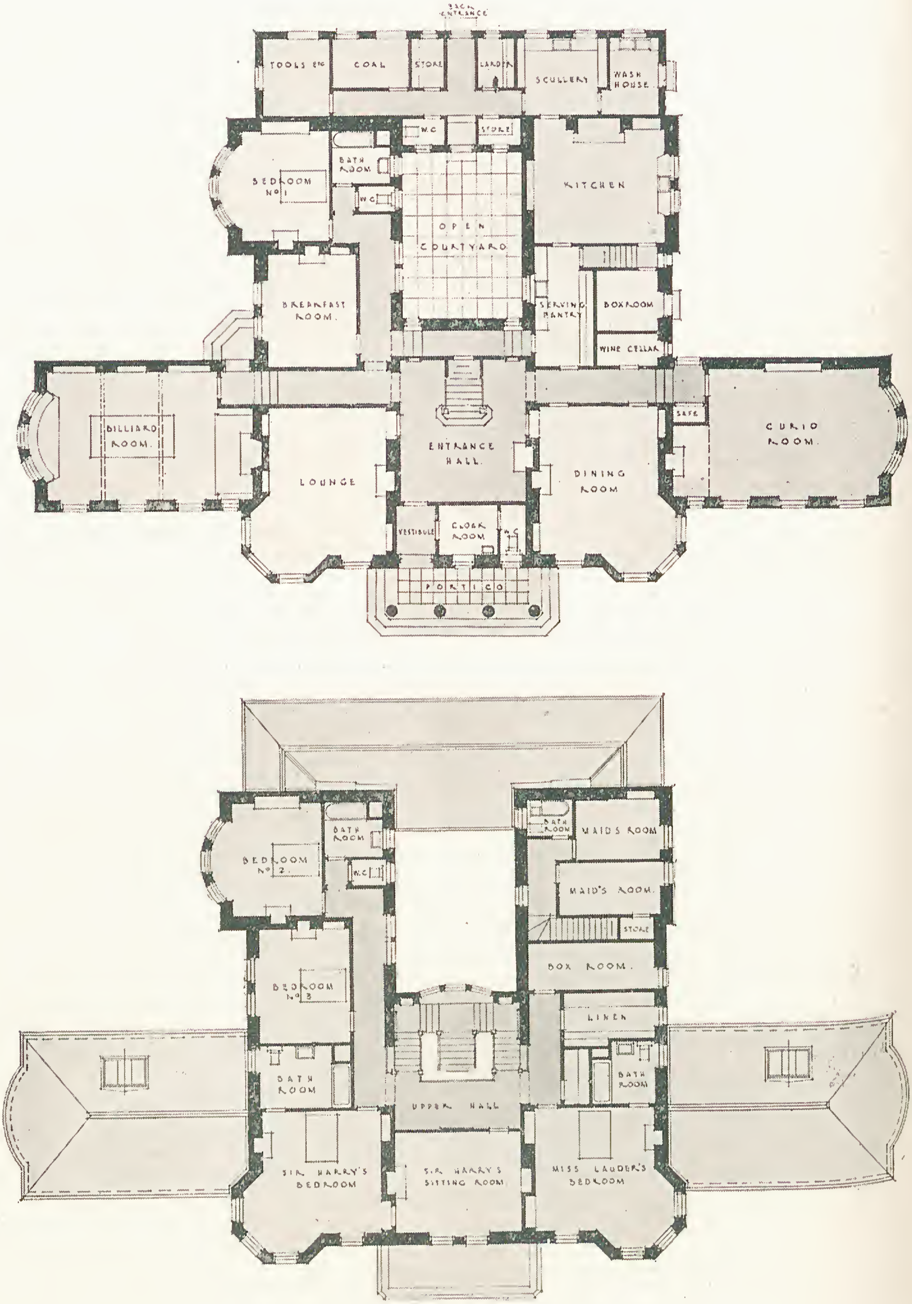


Fig. 19.—SIR H. LAUDER'S HOUSE—GROUND- AND UPPER-FLOOR PLANS

SHOPS AND STORES

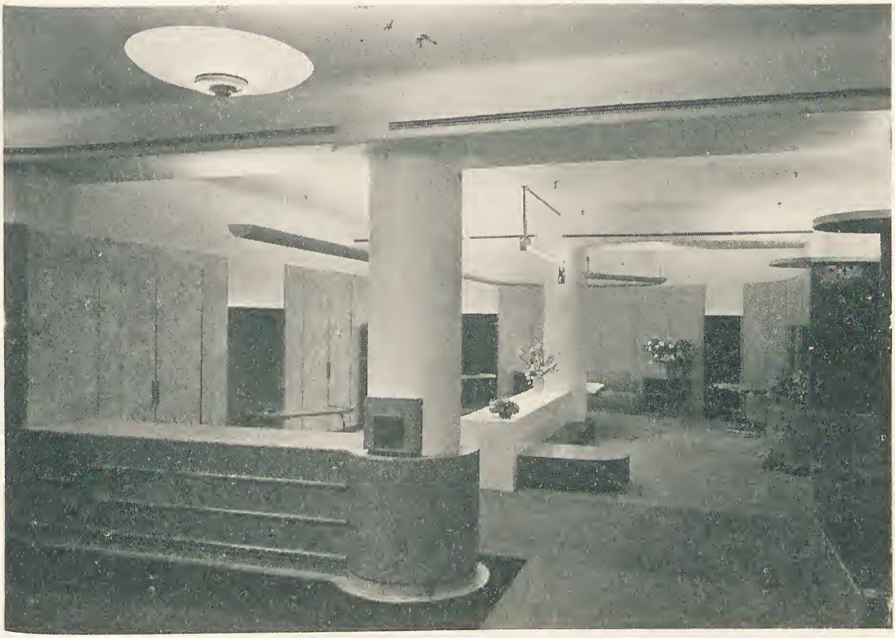


Fig. 1.—Dress clothes department, Messrs. Simpsons, Piccadilly, W.1
(*Architect : Joseph Emberton, F.R.I.B.A.*)

OBSERVATION of the large number of shops and stores which have been reconstructed in London alone during the last few years renders it quite clear that much care and thought have been expended recently on this important aspect of commercial life. A large store is like a miniature city, and as such must be planned and conceived in an orderly manner to provide efficiency of service and a congenial atmosphere for the customer. Pleasing and attractive surroundings, in which the customer may satisfy his wants, and efficient service, are absolutely essential to the success of any type of shop or store.

Classification

Although it is not possible to classify all shops and stores under specific heads, the following are the principal types :—

(1) Large stores (department) selling every conceivable type of goods.

Fig. 2.—OUTFITTING SECTION, CENTRE, GROUND FLOOR, MESSRS. SIMPSONS, PICCADILLY, W.1. (*Architect : Joseph Emberton, F.R.I.B.A.*)

(2) Large shops or stores restricted to one particular type of trade or commodity.

(3) Small shops restricted to one particular type of trade or commodity.

(4) Suburban, country, or village shops.

(5) Multiple shops, which may be of types (1), (2), or (3).

In all cases the problem in brief comprises :—

(*a*) Providing adequate and suitable means for display according to both the class of trade and the type of commodity.

(*b*) Planning to facilitate easy interchange of exhibits, goods, show-cases, etc., or even of whole departments ; i.e. flexibility of plan is very desirable.

(*c*) Selecting constructional methods and materials to give adequate service, and reduce maintenance and annual upkeep to a minimum.

The following factors have considerable bearing upon the planning and equipment :—

(1) The receiving of goods.
(2) The storage of goods.
(3) The display of goods.
(4) The selling of goods.
(5) The dispatching of goods.
(6) General administration.

For example, a "cash and carry" business, such as Woolworth's, is quite a different problem from that of an exclusive gown shop in the West End.

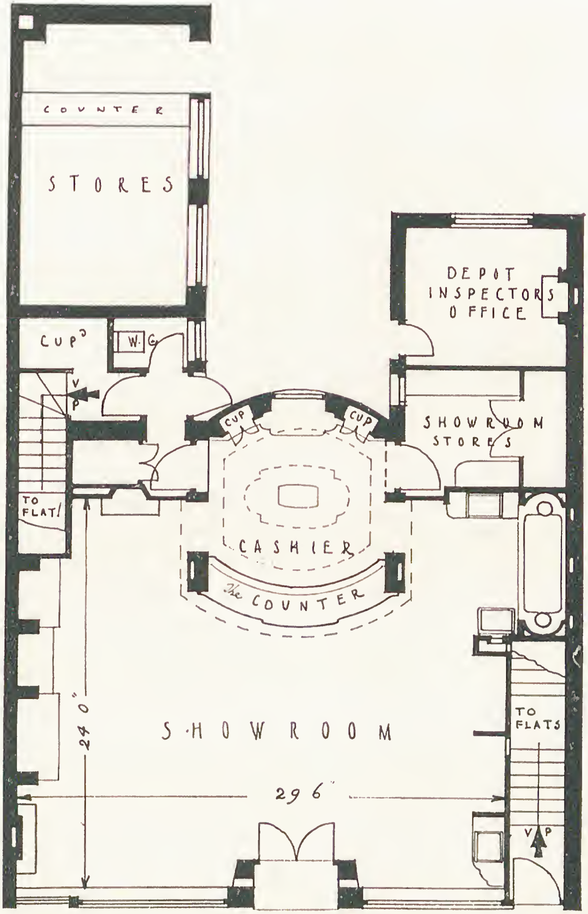


Fig. 3.—A GAS SHOWROOM

Muswell Hill showroom of the Tottenham & District Gas Co. Gas-heating and cooking appliances are placed in a series of recesses and are arranged to give working demonstrations. Note the bath, sinks, etc., for demonstrating instantaneous gas water-heaters, which are fitted. The showroom stores are placed centrally, whilst the depot inspector's office and stores department are grouped round the yard at the back, being at the same time fairly accessible to the showroom attendant and the cashier. Floors above are planned as flats. (*Architect : A. Douglas Robinson, F.R.I.B.A.*)

Site

The architect is seldom consulted other than in a technical way as to the selection of a site. The choice is dictated in many cases by factors outside the architect's scope; for example, strange though it may seem, one side of a street may prove an excellent stand while the opposite side is relatively poor, though there would appear to be no logical reason why such should be the case. Stopping-places for vehicles, both public and private; size, shape, and type of street; type of surrounding property; position of sun during the day, are but a few of the factors considered fully by the prospective owner. In general it may be taken that people must come to or pass by the site of their own volition. Hence arcades, for example, are much improved as a business proposition if they provide a short cut from street to street. At least two frontages are essential for stores and large shops, and very desirable for all shops. Delivery and dispatch should take place in a

Fig. 4.—ONE OF THE SHOPS, WATER LANE, WILMSLOW, CHESHIRE. (See also page 31)

The problem of designing the shops was a difficult one, for the site, although of considerable length, was only 30 ft. deep; it was impossible, therefore, to comply with the by-law which demands 15 ft. of clear space at the rear of the building. By arrangement, the local council agreed to permit this measurement to be reduced, provided only one storey high was planned in the centre of the site. These conditions were the governing factors in the grouping and designing of the buildings. The whole of the upper part of the buildings is built on a steel framework, so that any two shops may be joined together and form one large open space if so desired. Two of the shops have living accommodation above, comprising living-room, kitchen, larder, three bedrooms, bathroom, and w.c. Building is faced with $1\frac{7}{8}$-in. hand-made orange bricks. Roof, hand-made tiles. (*Architects : Oakley and Sanville.*)

position remote from the main public entrances. It is not desirable to have vans obstructing customers' cars, apart from the general inconvenience and traffic congestion likely to ensue if this is not observed.

It is not essential that the site should be a corner one. A corner site does provide extra light and display space, and it is likely that more people will pass the site ; on the other hand, more traffic congestion may be anticipated, and it is frequently more difficult to provide adequate circulation. A long, narrow site has the advantage of enabling light-wells to be reduced to a minimum. For large stores the minimum requirement is a good street front, with access to a secondary or service street, while an island site is by far the best, reducing the planning problems to a minimum.

Entrances

These should not be too numerous, as maintenance costs are increased as points of control are multiplied ; furthermore, as much frontage as possible is required for display purposes. In practice it will be found that the minimum requirements of the local authority with regard to " escape " in case of fire will control this issue.

It is not desirable to deliver customers on to a crowded street corner ; this frontage is valuable for display purposes.

Entrance doors may hang singly or in pairs. Single doors are preferable in that the provision of one door for each person entering or leaving avoids the confusion frequently seen when people try to both enter and leave via the same double doors. Doors should be set back from the building line, providing a recessed vestibule as a transition from shop to street. Steps should be avoided at entrances wherever possible—particularly short flights of one, two, or three steps. A definite flight of steps is possible, providing it is set well back from the street and has adequate landing space.

Spacing of Piers, Columns, etc.

The ideal plan from the point of view of arrangement of selling space would be one without any columns at all. This is not practicable, as it would entail deep floor beams which in turn would reduce effective headroom considerably. In the L.C.C. area in particular, where heights are restricted, such planning would prove impossible, and certainly expensive from a constructional point of view.

Column centres are controlled by : (*a*) the shape of the site ; (*b*) layout of fittings, together with public gangways and assistants' gangways ; (*c*) constructional costs. A square bay 21 ft. to 23 ft. square is usually found best suited to the layout of the selling space. This standard bay may, of course, have to be varied or increased in span, according to the exigencies of the site.

Cubic Capacity

In London, in the L.C.C. area, the regulations are particularly stringent, and among other things insist on the building being divided into self-contained units not exceeding 250,000 cu. ft. ; these units have to be so arranged that complete isolation is rendered possible in case of fire. These units may be provided by " horizontal " or " vertical " separation. Horizontal separation means that the units are planned over one another, and connected only by self-closing fire-doors, enclosed lift-shafts, and staircases. Obviously this arrangement renders the provision of moving escalators, open wells, etc., almost impossible. Vertical separation comprises planning the units side by side, and separated by " division walls " running vertically right up the building. Openings in these division walls are strictly regulated and controlled, and have to be fitted

Fig. 5.—Bon Marché, Gloucester
(*Architects : Healing and Overbury*)

with self-closing iron doors or shutters. The L.C.C. is now drafting new by-laws to replace the constructional clauses of the old Building Act, which in many respects is now obsolete. It is to be hoped that the rigid interpretation given to many of its clauses, including this division of a building into comparatively small units, will receive attention.

Vertical separation in stores is usually better, as it does allow of the use of open staircases, lifts, wells, connecting several floors, etc., all of which enable the wares to be seen. Restrictions elsewhere in the country are not so rigid as in London, and apparently in other countries there are no restrictions with regard to cubic capacity and open unrestricted floor space.

CIRCULATION

Public Gangways

The main public gangways are the means of access from the street to the various departments, are likely to be crowded, particularly at "peak" hours, and should be planned accordingly. A minimum width of 10 ft. may be accepted, with an average of 15 ft. These main arteries of the store should all lead somewhere—i.e. to other departments, lifts, escalators, stairs, etc., and should not terminate in blind spots or in culs-de-sac. Subsidiary gangways are provided off the main arteries, and it is along these subsidiary gangways that most of the customers

make their purchases. A minimum of 8 ft. is desirable if seating accommodation at the counters is provided.

Staff Gangways

Space required behind counters varies, of course, with the type of commodity being sold. An average space of 2 ft. 6 in. between counter and show-case or fitting behind allows of comfortable working, and permits assistants to pass one another.

Goods

A great deal of space is required for the receiving and dispatching of goods, with the necessary docks, etc., and provision for lorries. Freight lifts, about 6 ft. square, should discharge near the dispatch and receiving departments. A parcel chute should connect all selling floors to a sorting-room, say, in the basement. Similarly, a rubbish chute should serve all floors, facilitating quick and easy removal of all litter and rubbish.

Receiving and dispatch departments are better separate, if the plan will allow it ; goods are usually delivered by lorry, and must be unloaded, checked, unpacked, sorted, and sent either to stockrooms or direct to sales counters. Provision has to be made, therefore, for this work to be conducted. Lorries vary in size from 18 ft. to 30 ft. long, and up to 7 ft. 6 in. wide. The unloading dock is preferably raised some 2 ft. 6 in. to 3 ft. above the street level, to facilitate unloading and minimise damage and breakages. The freight lifts should be large enough to handle bulky goods such as pianos, shop fitments, etc., and should be placed adjacent to the unloading dock. There should be ample space between the back of the vans and the lifts for unpacking and sorting.

Stockrooms

Generally placed in basement or sub-basement. May be placed on top floor : this permits use of gravity-feed distribution chutes to selling floors for small articles. Natural light not essential, but good ventilation and dry atmosphere are. Standard metal shelves and bins may be used, with minimum 3-ft. gangways to take trolleys. Equipment should be standardised as far as possible to facilitate re-arrangement of storage space. Adequate vertical communication with all selling floors is essential.

Dispatch

After the sale goods may be taken to packing-rooms provided on each floor, or to a central packing-room adjacent to the actual dispatch dock. Special precautions against fire must be taken in this section, where much paper, straw, wood, wool, etc., are kept.

Vertical Circulation

Vertical communication is provided by means of staircases, lifts, and escalators ; their placing is particularly important, and closely related to

the provision of "means of escape" as required by the local authority. Requirements as to means of escape are seldom specified, but they must be "to the satisfaction of the authorities"; their requirements are based upon area, construction, number of people for whom escape is to be provided, sprinkler installation, fire-alarm installation. The main vertical means of circulation should be placed so that:—

(1) It is easily visible on entering the store.

(2) It does not cause congestion by the main entrances—this usually occurs when lifts are placed adjacent to entrances.

(3) Customers should approach the means of vertical travel via several stalls, departments, etc., thus increasing the possibility of a purchase on the way.

(4) Customers should be delivered in a fairly central position on each selling floor.

(5) Speed of access to upper floors has the effect of equalising the trading value of all floors. This is particularly important.

In general it will prove satisfactory to place the vertical transport in a central position, at the end of a main approach gangway flanked with display and selling counters. In the case of narrow sites, lifts, etc., may be placed on the back wall facing the main entrance, customers thus passing right across the store.

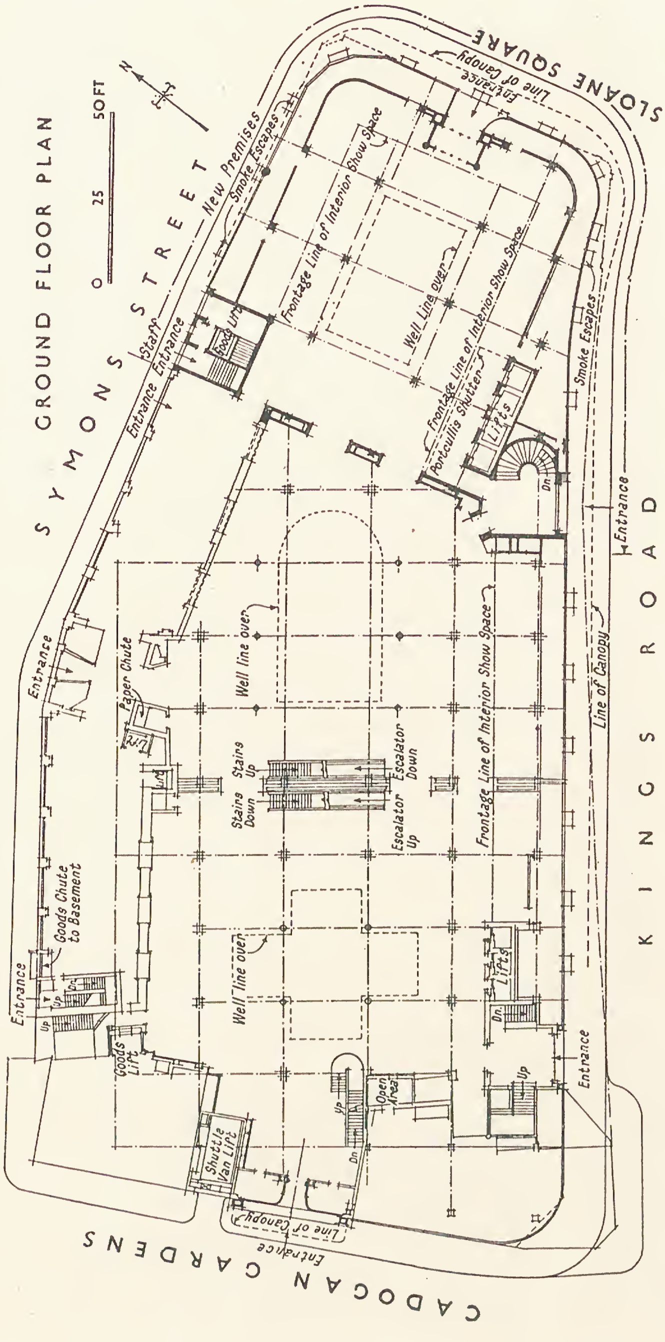
Staircases

The number and size of staircases are dictated by the floor area of the store. To date, the L.C.C. have based their requirements on the number of people likely to be evacuated; this is difficult to compute, and the latest regulation is one which requires 6-in. width of staircase for every 1,000 ft. of site area.

Staircases are usually 4 ft. 6 in. to 5 ft. wide, and it is generally considered better to increase their number rather than their width, to meet the requirements. In fact, wide staircases are dangerous where large numbers of people may use them.

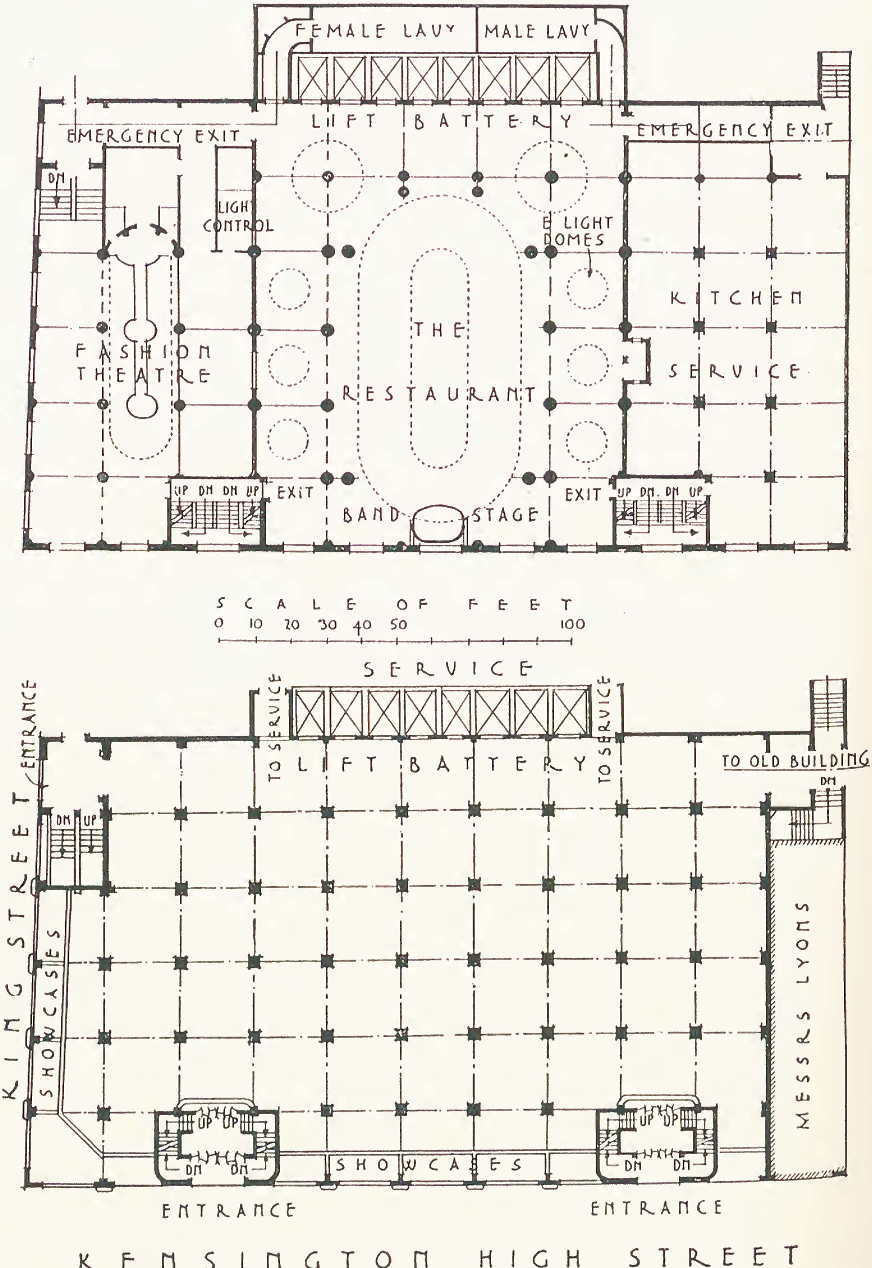
Open staircases can be used only if the space connected by them does not exceed 250,000 ft. cube. They are therefore usually enclosed with fire-resisting materials, and approached by means of fire-resisting smoke-doors which must open outwards from the selling floors and swing clear of the stair landings—i.e. the doors much be set back so as not to encroach on the landing, which must be unrestricted for the full width of the staircase it serves.

Staircases should have natural light and ventilation; this means placing them on outside walls which in turn facilitates escape in case of fire. Staircases should be taken up to the roof. Treads should not be less than 10 in., nor risers more than $7\frac{1}{2}$ in.



[By courtesy of "Building"

Fig. 6.—PETER JONES' STORE, LONDON—GROUND-FLOOR PLAN
(*Architects : Slater & Moberly, FF.R.I.B.A.*)



[By courtesy of "Building"

Fig. 7.—DERRY & TOMS' STORE, LONDON—GROUND-FLOOR AND TOP-FLOOR PLANS
(*Architect: Bernard George, A.R.I.B.A.*)

Lifts

The following points should be considered in connection with lifts :—

(1) It is usually best to group them together. This provides alternative accommodation for the customer, and concentrates machinery.

(2) A long row of lifts is not very satisfactory, as people are apt to rush backwards and forwards at peak hours when lifts are full, thus adding to the congestion. A sound scheme is to place lift batteries facing each other, with a wide (15-ft. minimum) lobby between them.

(3) Relatively small high-speed lifts are better than large slow-moving lifts ; similarly, cars are preferably wide and shallow rather than narrow and deep, facilitating egress at each floor level.

(4) " Up " and " down " batteries should be provided, with express lifts to such floors as restaurant.

(5) Lift doors should be sliding doors, not hinged, and should open the full width of the car.

(6) Both lift and gates should be worked by an operator ; lifts should discharge on only one side.

(7) The lift should be self-levelling, finishing level with each floor, thus obviating accident.

(8) Lifts which are placed in open wells should not be adjacent to escape staircases.

(9) Lift machinery has invariably to be placed on the roof, as basement space is too valuable.

All the technical requirements of lifts should receive special attention with regard to safety, ease of running, etc.

Moving Escalators

Moving escalators may now be used, though not on open floors. The difficulty may be overcome by the provision of fire cut-off lobbies at each end, and enclosing them in fire-resisting materials. One solution of the " cube difficulty " is to place the escalators and lifts (i.e. all vertical circulation) in a separate hall or lobby which is taken right up the building, and planned as a self-contained unit for cube purposes.

Great advantage in use of escalators is saving of time in waiting. It is computed that a 3-ft. stair, as used on the Tube, can move 8,000 passengers per hour ! ! Escalators are usually placed at an angle of 30°, and travel at 90 ft. a minute.

On examination it will be found that escalators do not take up nearly so much space as may be imagined. Escalators may be planned over one another, which means that the customer has to walk between the ends of each flight at each floor level, or they may be placed crossing over each other, and serving in two directions, which leads to less congestion.

The driving-end or motor is placed at the top of the escalator ; a depth of only 5 ft. or so is required, thus there is ample room for show-cases underneath, assuming a normal floor-to-floor height of 15 ft.

Floor Heights

The heights of floors are in part controlled by the maximum building height laid down by the local authorities. In common with all other types of commercial buildings, a part of the problem is that of providing as many revenue-producing floors as possible in a given height.

A minimum height in the clear of 12 ft. is considered necessary.

Office and administrative floors need not be more than 10 ft. or 10 ft. 6 in. in the clear.

Several basements may be provided, at least one being used for selling purposes, with mechanical equipment placed in a sub-basement.

The value of natural light in a store is questionable. Really good natural light is probably an advantage ; an all-pervading gloom, such as is almost bound to ensue on the ground floor, due to the small amount of window space available, is probably best dispersed by the use of permanent artificial illumination. Experiments are being made in America with a store having no natural light or ventilation at all.

The superimposed floor load to be carried in a store varies somewhat according to the type of goods in the various sections. An average load is about 170 lb. per square foot ; this may be increased up to 300 lb. per square foot for heavy materials, such as linoleum and carpets.

Departments

The following are the main divisions of the average store, together with the various types of goods catered for under each head :—

(1) *Furnishing and Household Goods*, comprising : furniture, linoleum, carpets, rugs, bedding, soft furnishings, interior decoration, ironmongery, china, glass, etc.

(2) *Piece Goods*, comprising : materials bought by the yard, silks, velvets, cottons, worsteds, woollens, etc. ; cut lace, ribbons, haberdashery, paper patterns, wool, etc.

(3) *Fashions :* comprising coats, costumes, model gowns, furs, blouses, jumpers, shoes, stockings, trimmings, etc. ; accessories, such as umbrellas, handkerchiefs, perfumery, jewellery, lingerie, babies' requisites, children's clothes, etc.

(4) *Special Saloons* needing seclusion, such as : hairdressing, chiropody, corsets, mannequin theatre, etc.

(5) *Men's Wear.*

(6) *Fancy Goods :* beads, pens, gifts, arts and crafts department, note-paper, trunks, leather goods, etc.

(7) *Food and Wines :* snack-bars, soda-fountains, etc.

(8) *Drugs :* patent medicines and dispensary.

(9) *Recreation and Sports.*

(10) *General Services :* travel bureau, theatre tickets, information bureau, waiting-room, rest room, bank, storage, etc.

A restaurant is invariably provided in large modern stores. The kitchens serve both restaurant, and canteen for the staff.

Cash and Administration

The usual methods of taking cash comprise :—

(*a*) A cash-register to each section of the various departments.

(*b*) A centralised cash room, connected to all parts of the store by pneumatic dispatch tube. This service is also valuable, as messages, orders, invoices, etc., can be conveyed to all parts of the store with minimum waste of time. A disadvantage is that there is some slight delay for the customer, though little fault may usually be found. The central cash department probably reduces to a minimum the number of mistakes attributable to the human element. The cash room should be in a central position.

The administrative section of the store is not usually visited by the public, and may be placed where space is not so valuable, i.e. the top of the building. It comprises accommodation for the directors, secretariat, accountancy, advertising, post department, telephone exchange, maintenance, etc.

Staff Accommodation

A separate entrance for staff should be provided ; usually a time-keeper's office adjoins this entrance. Ample locker accommodation is necessary for the staff, as many will have to change their clothes ; these locker rooms may be placed in the basement, and be artificially lit and ventilated. Lockers are of metal, about 1 ft. 3 in. square and 6 ft. 6 in. high, and raised on legs to facilitate cleaning and ventilation.

Staff lavatories are best provided on each floor : much time is saved by this arrangement, which is also more convenient for the employees.

Shop Fronts

In London, shop fronts are controlled by building regulations, among which the following are found :—

(1) Total area of openings in the whole façade above ground-floor level must not exceed one-half of the total area of the wall.

(2) In streets less than 30 ft. wide, shop fronts may not project more than 5 in. beyond external wall of the building, and cornices 13 in.

(3) In streets of greater width than 30 ft., 10 in. and 18 in. respectively.

(4) No woodwork to shop front may be fixed higher than 25 ft. from the pavement, nor nearer than 4 in. to centre of a party wall. If party wall does not exist, a minimum of 4 in. of incombustible material is required between the woodwork for the full height.

The two principal types of shop front are :—

(1) Those in which a permanent window back is provided, forming a background to the display.

(2) Those in which there is no window back, and it is possible to see right into the shop. This, of course, increases the display accommodation and improves the lighting, but is not applicable to all trades.

The window back itself may be taken right up to the shop ceiling, or may finish at transome level, allowing clerestory lighting to the shop over the shop window, or alternatively providing space over the display portions for lighting fittings.

Blinds are usually essential for most trades.

The shop window itself varies in height from 6 in. above the street level to 3 ft. 6 in. Jewellers, and shops of this type, may have a display window 3 ft. 6 in. from the ground, and very shallow, say 2 ft. deep; a furniture shop, on the other hand, requires the articles displayed to be placed at a much lower level, and requiring a window some 12 ft. deep.

One of the great difficulties experienced to date in connection with shop windows has been that of dispensing with the reflections, which make it difficult to see the goods behind the window. Much experiment has been and is being made with shop windows bent to a parabolic shape, which causes the rays of light falling thereon to be diverted from the eye.

The design of the shop front is dictated by :—

(*a*) The type and class of wares displayed and sold.

(*b*) The type of shop and its surround.

(*c*) Personal taste of the owner.

The possibilities are legion, a few being :—

(1) The shop window may be flush with the main building face.

(2) It may project the maximum 10 in. allowed by the L.C.C.

(3) It may be recessed in shaped bays between the supporting piers, allowing people to stand clear of the main traffic on the pavement.

(4) It may be recessed completely behind the supporting piers, i.e. an open arcade.

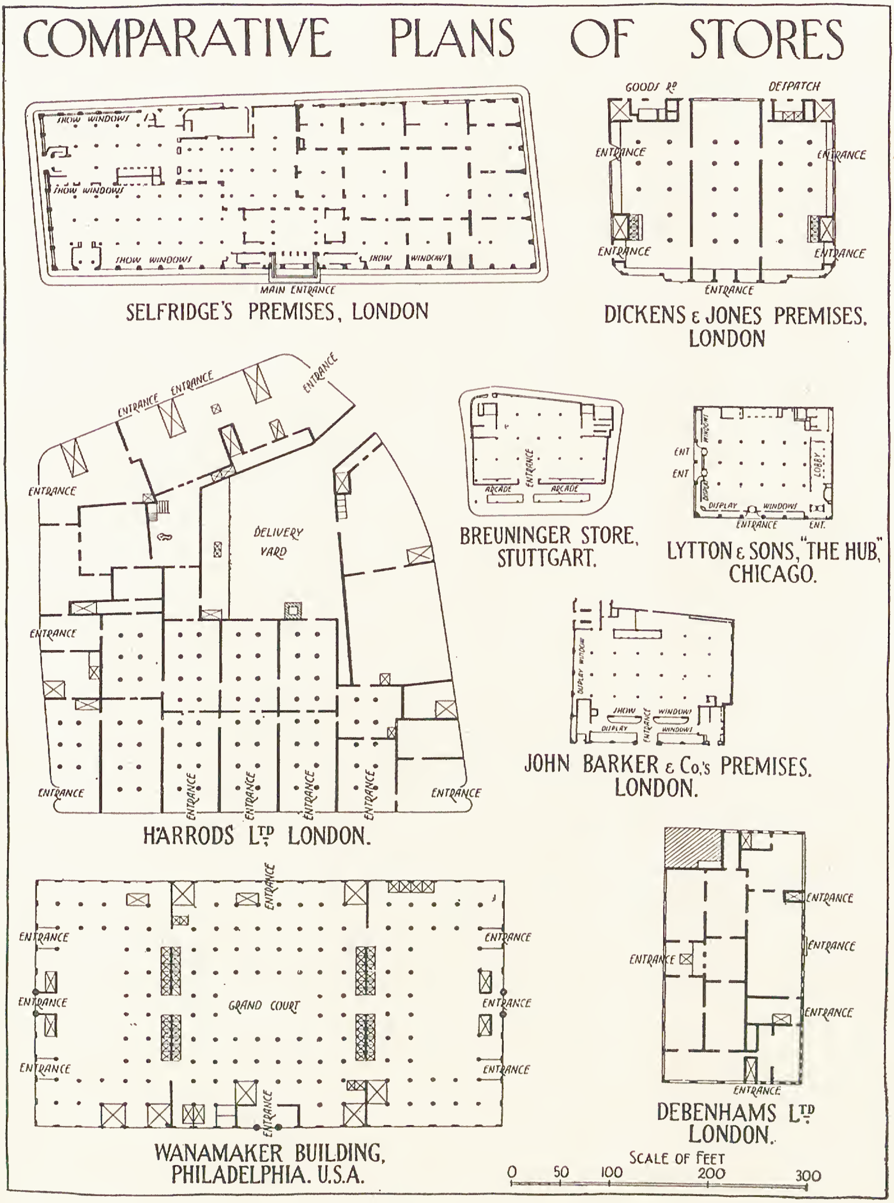
(5) It may be a deep-recessed type, with numerous show-cases placed between the street and shop entrance. This arrangement reduces the area of the shop, but increases the display accommodation.

(6) Use may be made of the special non-reflecting types of window previously mentioned.

Shop fronts are best not too wide—16 ft. to 18 ft. is sufficient for the average small shop. Multiple stores may perhaps be 25 ft. or so. If shops are made too wide it will be found that they tend to become subdivided into two small units—usually with disastrous results to the design of the front. In the suburban type of shop, where the tenant usually lives over the shop, the provision of the flat over determines the actual width of the shop.

Arcades

An arcade form of arrangement is sometimes a very useful method of developing a deep plot, with lock-up shops, and possibly offices over.



[By courtesy of "Building"

Fig. 8.—COMPARATIVE PLANS OF WELL-KNOWN STORES

Fig. 9.—GAS SHOWROOM WITH FLATS OVER
External brickwork in orange facings.

An arcade, however, *must* provide a short cut between, say, two streets, so that the public will automatically pass through it. In general, shopkeepers dislike the arcade.

A minimum width of 12 ft. is essential ; 16 ft. to 18 ft. is much better. The shops themselves are usually small, 12-ft. to 15-ft. frontage, and comprise the luxury and precious or exclusive type of goods.

BUILDER'S ESTIMATING

PART IV.—FOUNDER AND SMITH—PLASTERER—SLATER—TILER—PLUMBER—PAINTER—PAPER-HANGER—POLISHER—GLAZIER

FOUNDER AND SMITH

Cast-iron Rain-water and Soil Pipes

THE following labour values are for fixing pipes from scaffold; equal times of plumber and mate.

LABOUR—FIXING PIPES AND FITTINGS

	Pipes from 2-in. to 3-in. Diameter	*Pipes $3\frac{1}{2}$-in. and 4-in. Diameter*
Rain-water pipes with red-lead joints		
Pipe, per foot run	$\frac{1}{10}$ hour	$\frac{1}{8}$ hour
Shoes, each	$\frac{1}{5}$,,	$\frac{1}{4}$,,
Rain-water heads, ordinary size, each	$\frac{1}{3}$,,	$\frac{1}{3}$,,
ditto large, each	$\frac{1}{2}$,,	$\frac{1}{2}$,,
Bends, extra labour, each	$\frac{1}{4}$,,	$\frac{1}{3}$,,
Offsets, up to 15-in. projection, ditto	$\frac{1}{4}$,,	$\frac{1}{3}$,,
Offsets, above 15-in. projection, ditto	$\frac{1}{3}$,,	$\frac{1}{2}$,,
Branches, ditto	$\frac{1}{3}$,,	$\frac{1}{2}$,,
Soil pipes with caulked lead joints		
Pipe, per foot run	$\frac{1}{6}$,,	$\frac{1}{5}$,,
Bends, extra labour, each	$\frac{1}{3}$,,	$\frac{1}{2}$,,
Offsets, up to 15-in. projection, ditto	$\frac{1}{3}$,,	$\frac{1}{2}$,,
Offsets, above 15-in. projection, ditto	$\frac{1}{2}$,,	$\frac{2}{3}$,,
Single branches, ditto	$\frac{1}{2}$,,	$\frac{2}{3}$,,
Double branches, ditto	$\frac{3}{4}$,,	1 ,,

Cast-iron gutters

LABOUR—FIXING GUTTERS FROM SCAFFOLD

	Plumber and Mate
Common half-round and ogee gutters up to 6 in. and small moulded gutters, per foot run	$\frac{1}{7}$ hour
Stop ends, each	$\frac{1}{7}$,,
Outlets, extra labour, each	$\frac{1}{5}$,,
Angles, ditto	$\frac{1}{4}$,,
Moulded gutters, size 5 in. by 4 in. and 6 in. by 4 in. per foot run	$\frac{1}{5}$,,
Stop ends, each	$\frac{1}{5}$,,
Outlets, extra labour	$\frac{1}{4}$,,
Angles, ditto	$\frac{1}{3}$,,

Detailed Price Analysis

(60) *4-in. diameter cast-iron rain-water pipe, ordinary metal, fixed 2 in. clear of walls with distance pieces.*

			s.	d.
1 ft. 4 in. cast-iron rain-water pipe	@ 3*s.* 7*d.* yd., net		1	2½
Waste, including the provision of short lengths of pipe, 10 per cent.				1½
		d.		
Red lead for one joint		3		
Pipe nails		1		
2 gas-barrel distance pieces		6		
		5)10		2
Plumber and mate, ⅛ hour	@ 2*s.* 11*d.*			4½
	Per foot run, net		1	10½

Note.—The total value of joint and fixings is divided by the average length of pipe, in this case assumed to be 5 ft.

(61) *Extra to 4-in. single branch.*

		s.	d.
1 4-in. single branch	net	3	10
Materials for two joints			6
Plumber and mate, ½ hour	@ 2*s.* 11*d.*	1	5½
		5	9½
Deduct 1 ft. run of rain-water pipe displaced by branch		1	2½
	Extra value, each, net	4	7

(62) *4-in. rain-water shoe*

			s.	d.
1 4-in. rain-water shoe	net		2	9
		d.		
Red lead for joint..		3		
Pipe nails		1		
2 gas-barrel distance pieces		6		
				10
Plumber and mate, ¼ hour	@ 2*s.* 11*d.*			8¾
	Each, net, say		4	4

(63) *3½-in. cast-iron L.C.C. weight coated soil pipe, jointed with molten lead and fixed with hinged holderbats built into brickwork.*

		s.	d.	s.	d.
1 ft. 3½-in. L.C.C. coated soil pipe	@ 4*s.* 6*d.* yd., net			1	6
Waste, including the provision of short lengths of pipe, 10 per cent.					1¾
3 lb. lead for joint, @ 4*d.*		1	0		
Gaskin and firing			1		
1 3½-in. hinged holderbat		3	6		
Labour building in holderbat			9		
		5)5	4	1	1
Plumber and mate, ⅕ hour	@ 2*s.* 11*d.*				7
	Per foot run, net, say			3	4

PLASTERER

Lathing

The quantity of fir laths required to cover 1 yard super, allowing 10 per cent. for waste and ¼ in. spacing between the laths, is 100 ft. run.

A bundle of sawn laths contains 500 ft. run and a bundle of rent laths 360 ft. run. The area covered by a bundle of sawn laths is 5 yd. super and rent laths 3½ yd. super.

Expanded metal lathing is sold in sheets 2 ft. by 9 ft. Waste value 10 per cent. for ceilings, etc.; and 20 per cent. for beam and stanchion casing.

Labour fixing fir or metal lathing to ceilings, ¼ hour per yard super; to beam and stanchion casing ½ hour per yard super.

Plastering—Labour Values

The following labour values include for the erection of split-head scaffold for storey heights not exceeding 11 ft. For work above this height the cost of erecting suitable scaffolding must be added, the actual figure varying with the total height and character of the building.

The plasterer needs more attendance from labourers when applying rendering coats than for the setting coat, etc., but on work of average size one labourer should mix material for and serve two plasterers, taking the work as a whole.

Labour values are given for some of the more common types of plastering in general use.

Labourer's time to be taken at one-half of the time given for plasterer.

Per yard super.	*Plasterer*
Rough rendering in lime and hair	$\frac{3}{10}$ hour
Render, float, and set in lime putty	$\frac{5}{8}$,,
Portland cement floor screed, ½ in. thick	$\frac{1}{3}$,,
Portland cement wall screed ½ in. thick	$\frac{2}{5}$,,
Portland cement plain face	¾ ,,
Two coats Sirapite plastering	¾ ,,
Keene's cement on Portland cement backing	⅞ ,,
White cement rendering	1 ,,

Work in Small Quantities and Narrow Widths

For plastering in detached surfaces not exceeding 1 yd. super in area (small quantities) and to surfaces exceeding 6 in. but not exceeding 12 in. wide (narrow widths), allow twice the normal labour values.

The price for narrow-width work not exceeding 6 in. wide should be based upon 2½ times the normal labour values.

Running Labours

The following are net cost prices, labour only.

Per foot run.	*Plaster*	*Sirapite, Portland, and Keene's cement*
	d.	*d.*
Arris	1	1¼
Arris and fair edge	1¾	2
Quirk	¾	1
Make good to metal frame	¾	1
Small rounded angle	1½	2
Rounded angle, 2 in. girth	2½	3¼
Flush bead and quirk	3½	4¾

Mouldings

Basis labour values for mouldings and plain cornices, 12 in. girth.

Per foot run super.	*Plasterer*
Plaster	½ hour
Portland cement	¾ ,,
Keene's cement	⅞ ,,

Add to basis labours for mouldings, etc., under 12 in. girth :—

9 in. and under 12 in girth	10 per cent.
6 in. and under 9 in. girth	20 ,, ,,
3 in. and under 6 in. girth	33 ,, ,,

Add for circular work 25 per cent.

The price of intersections of mouldings and cornices, for both labour and materials, is usually based upon the value of the straight moulding, thus :—

Mitres	Charged as equal to 1 ft. run of moulding
Irregular mitres	,, ,, ,, ,, 1½ ft. ,, ,, ,,
Stopped ends	,, ,, ,, ,, ½ ft. ,, ,, ,,
Mitred and returned ends	,, ,, ,, ,, 1½ ft. ,, ,, ,,

Materials

The cost of materials required per yard super of plastering may be calculated by dividing the cost of 1 yd. cube (an area of 9 sq. ft., 36 in. thick) by the thickness of the plaster coat in inches. Thus, for a rendering ½ in. thick, the cost of material per yard cube would be divided by 72. Due allowance must be made for consolidation of materials and for "key."

The usual thicknesses of plastering, exclusive of key, are as follows :—

Two-coat work	⅝ in. thick
Three-coat work	⅞ in. ,,
Two-coat work in patent plasters	½ in. ,,
Setting coat only	⅛ in. ,,

On certain classes of work the thickness of the rendering coat may be increased due to inequalities in the wall surface.

Owing to space limitations it is impossible to give detailed analyses of the cost of materials for each type of plastering. Using the method given for Sirapite plastering, the following additions should be made to the cost of the net quantity of materials to provide for shrinkage in mixing, in addition to the 10 per cent. allowance for consolidation by trowelling :—

Lime and hair mortar	33 per cent.
Portland cement mortar	25 ,, ,,
Keene's cement, neat setting coat	10 ,, ,,

Setting only in lime putty requires ½ yd. cube of chalk lime per 100 yd. super.

The method of arriving at the cost of lime and cement mortars has previously been given in these articles (Vol. I, p. 135).

Examples of Detailed Price Analysis

(64) *Sawn fir lathing.*

		s.	d.
$\frac{1}{5}$ bundle $\frac{1}{4}$-in. sawn fir laths	@ 2s. 3d.		5½
$\frac{1}{4}$ lb. wire lath nails	@ 5d.		1¼
Lather, $\frac{1}{4}$ hour	@ 1s. 5d.		4¼
	Per yard super, net		11

(65) 24 *g. expanded metal lathing.*

		s.	d.
1 yd. super 24 g. expanded metal lathing	@ 11*d*.		11
Waste, 10 per cent.	.. ..		1
Staples	.. ..		1
Lather, $\frac{1}{4}$ hour	@ 1s. 5d.		4¼
	Per yard super, net	1	5¼

(66) 24 *g. expanded metal lathing in beam casing.*

		s.	d.
1 yd. super 24 g. expanded metal lathing	.. ..		11
Waste, 20 per cent.	.. ..		2¼
Staples	.. ..		1½
Lather, $\frac{1}{2}$ hour	@ 1s. 5d.		8½
	Per yard super, net	1	11¼

Sirapite Plaster.

Coarse Sirapite .. .. £3 10*s*. per ton—say 2*s*. 8*d*. per bush., including sack hire.
Fine Sirapite .. .. .. £3 18*s*. per ton—say 3*s*. per bush., including sack hire.
Weight of Sirapite, 82 lb. per bush.

(67) *Sirapite mortar* (1 : 3) *for rendering coat.*

		£	s.	d.
1 yard coarse Sirapite—21 bush.	@ 2*s*. 8*d*.	2	16	0
3 yards washed sand	@ 8*s*. 0*d*.	1	4	0
		4	0	0
Add 25 per cent. to provide 20 per cent. shrinkage from total bulk of materials		1	0	0
		5	0	0
Add 10 per cent. for consolidation in trowelling			10	0
Divide by number of parts in mix	4)	5	10	0
	Per yard cube	£1	7	6

Per yard super, $\frac{3}{8}$ in. thick—3¼*d*.

(68) *Neat Sirapite for finishing coat.*

		£	s.	d.
1 yard cube fine Sirapite—21 bush.	@ 3*s*. 0*d*.	3	3	0
Add for consolidation 10 per cent.	.. ..		6	4
	Per yard cube	£3	9	4

Per yard super $\frac{1}{8}$ in. thick—say 3*d*.

(69) *Render and set in Sirapite on brick.*

		s.	d.
1 yard super 1 : 3 Sirapite mortar, $\frac{3}{8}$ in. thick.. ..	.. ..		3¼
Plus 5 per cent. extra material for key..	.. ..		¼
1 yard super neat fine Sirapite, $\frac{1}{8}$ in. thick	.. ..		3
Plasterer, $\frac{3}{4}$ hour	@ 1*s*. 8*d*.	1	3
Labourer, $\frac{3}{8}$ hour	@ 1*s*. 3*d*.		5½
	Per yard super, net	2	3

(70) *Render and set in Sirapite on brick, in small quantities or narrow widths over 6 in. wide.*

Basis price per yard super.		s. d.
Materials as example No. 69		6½
	s. d.	
Basis labour as before	1 8½	
Extra for small quantities, 100 per cent.	1 8½	
		3 5
Per yard super, net		3 11½

Per foot super, $\frac{3s.\ 11\frac{1}{2}d.}{9}$, say $5\frac{1}{4}d.$

(71) *Render and set in Sirapite on brick, in narrow widths, not exceeding 6 in. wide.*

Basis price per yard super.		
Materials as example No. 69		6½
	s. d.	
Basis labour as before	1 8½	
Extra for narrow widths, 150 per cent.	2 6¾	
		4 3¼
Per yard super, net, say		4 10

Per foot super, $\frac{4s.\ 10d.}{9}$, $6\frac{1}{2}d.$

Per foot run, 6 in. wide, $3\frac{1}{4}d.$

(72) *Plaster moulded cornice, 12 in. girth.*

Plasterer, ½ hour	@ 1*s.* 8*d.*	10
Labourer, ¼ hour	@ 1*s.* 3*d.*	3¾
Materials		2¼
Per foot super, net		1 4

Mitres	1*s.* 4*d.* each
Irregular mitres	2*s.* 0*d.* ,,
Stopped ends	8*d.* ,,
Mitred and returned ends	2*s.* 0*d.* ,,

SLATER

In the following table the number of slates given per square includes an allowance of 5 per cent. for waste.

Size of Slates	*Per Square*				
	Slates		*Nails*		*Labour*
	3-in. Lap, Head Nailed	*3-in. Lap, Centre Nailed*	*Copper*	*Composition*	
			lb.	*lb.*	*s. d.*
18 in. × 9 in. ..	242	225	3	2¼	10 0
20 in. × 10 in. ..	189	179	2⅓	1¾	8 6
20 in. × 12 in. ..	158	150	2	1½	7 6
22 in. × 12 in. ..	141	133	1⅘	1¼	7 6
24 in. × 12 in. ..	126	121	1⅔	1⅙	7 6

Random-size slates for laying in diminishing courses are sold by the ton. A ton of best-quality slates laid to a 3-in. lap covers about $2\frac{3}{4}$ squares including waste. Labour sorting, holing, and laying, about 12*s.* per square.

Running Extras and Cuttings

The various extras such as eaves, verges, cuttings, etc., are charged on the basis price of a square of slating, allowing a definite width for each item. The allowances given in column (*a*) are for regular coursed slating and in column (*b*) for slating laid in diminishing courses.

	Allowance in Width of Slating by 1 ft. in Length (*a*)	(*b*)
Per foot run.		
Top edges	6 inches	9 inches
Square abutments	6 ,,	9 ,,
Verges	6 ,,	9 ,,
Verges on rake	9 ,,	12 ,,
Raking cutting	9 ,,	12 ,,
Cutting to valleys (each side measured)	9 ,,	12 ,,
Cutting to hips (ditto)	9 ,,	12 ,,
Eaves	12 ,,	18 ,,
Raking eaves	18 ,,	24 ,,
Circular cutting	12 ,,	15 ,,
Slate and half to verge, additional	9 ,,	12 ,,
Slate and half to hips and valleys, additional each side	9 ,,	12 ,,
Extras—per foot run. Mitred hips and valleys (in addition to cutting allowance)	*s.* *d.* 1 0	*s.* *d.* 2 0
Bedding and pointing verge	3	
Slate undercloak to verge	4	
Fixing soakers, per dozen	9	

Detailed Price Analysis

(73) 20 *in. by* 12 *in. best Bangor slating,* 3-*in. lap, centre nailed with composition nails.*

		£	*s.*	*d.*
150 20 in. by 12 in. best Bangor slates	@ £22 per thousand d/d	3	6	0
$1\frac{1}{2}$ lb. composition nails	@ 7*d.* lb.			$10\frac{1}{2}$
Labour, holing and laying			7	6
	Per square, net	£3	14	4

Eaves—1 ft. run by 12 in. wide—1 ft. super @ £3 14*s.* 4*d.* per square—9*d. per foot run.*

Top edges—1 ft. run by 6 in. wide—$\frac{1}{2}$ ft. super @ £3 14*s.* 4*d.* per square—$4\frac{1}{2}$*d. per foot run.*

(74) *Best-quality random-size slates laid to a* 3-*in. lap in diminishing courses and nailed with copper nails.*

		£	*s.*	*d.*
$\frac{4}{11}$ ton best-quality random slates	@ £11 per ton	4	0	0
$2\frac{1}{2}$ lb. copper nails	@ 1*s.* 3*d.* per lb.		3	$1\frac{1}{2}$
Labour, sorting, holing, and laying			12	0
	Per square, net, say	£4	15	0

Eaves—1 ft. run by 18 in. wide—$1\frac{1}{2}$ ft. super @ £4 15*s.* per square—1*s.* 5*d. per foot run.*

Top edges—1 ft. run by 9 in. wide—$\frac{3}{4}$ ft. super @ £4 15*s.* per square—$8\frac{1}{2}$*d. per foot run.*

TILER

Plain Tiling

The number of tiles per square is based upon tiles size $10\frac{1}{2}$ in. by $6\frac{1}{2}$ in. and includes 5 per cent. for waste.

Gauge of Tiling	*No. of Tiles*	*Per Square*			
		Galvanised Nails		*Labour*	
		Each Course Nailed	*Every 4th Course Nailed*	*Each Course Nailed*	*Every 4th Course Nailed*
				s. d.	*s. d.*
4 inches ..	582	6	$1\frac{1}{2}$	9 6	8 0
$3\frac{1}{2}$,, ..	665	$6\frac{3}{4}$	$1\frac{3}{4}$	11 0	9 3
3 ,, ..	776	$7\frac{3}{4}$	2	13 0	11 0

Running Extras and Cuttings

The charges for running extras and cuttings are based in a similar manner to that given for slating, but it should be noted that there is a variation from the slating allowances in some cases.

Per foot run.	*Allowance in Width of Tiling by 1 ft. in Length*
Top edges	6 inches
Square abutments	6 ,,
Verges	6 ,,
Verges on rake	9 ,,
Raking cutting	9 ,,
Cuttings to valleys (each side measured)	9 ,,
Cutting to hips ,, ,, ,, ...	9 ,,
Eaves	8 ,,
Raking eaves	14 ,,
Circular cutting	12 ,,

Extras per foot run.	*s.*	*d.*
Mitred hips and valleys (plus the cutting allowances)	1	6
"Laced" valleys, including cutting and waste	3	0
"Swept" valleys, ,, ,, ,, ,, ...	7	6
Bedding and pointing verge		3
Bedding and pointing verge, including single undercloak		8

Detailed Price Analysis

(75) *Best Staffordshire machine-made tiles. Prime cost* £4 10*s. per thousand d/d, laid to a 4-in. gauge, each tile nailed with two galvanised nails.*

		£	s.	d.
582 best-quality machine-made tiles	@ 90*s.*	2	12	4
6 lb. galvanised nails	@ 7*d.*		3	6
Labour, laying			9	6
	Per square, net	£3	5	4

Eaves—1 ft. run by 8 in. wide—$\frac{2}{3}$ ft. super @ £3 5*s.* 4*d.* per square—$5\frac{1}{2}d.$ per foot run.

Raking eaves—1 ft. run by 14 in. wide—$1\frac{1}{6}$ ft. super @ £3 5*s.* 4*d.* per square—9*d.* per foot run.

(76) *Best Staffordshire machine-made tiles, as before, laid to a 4-in. gauge, nailed every fourth course.*

		£	s.	d.
582 best-quality machine-made tiles	@ 90*s.*	2	12	4
$1\frac{1}{2}$ lb. galvanised nails	@ 7*d.*			$10\frac{1}{2}$
Labour, laying			8	0
	Per square, net	£3	1	3

(77) *Valley tiles laid to 4-in. gauge and bonded with tiling.*

		s.	d.
3 valley tiles	@ 8*s.* doz.	2	0
Nails, etc.			$\frac{1}{2}$
Labour, fixing			4
	Per foot run, net, say	2	5

(78) *Half-round ridge tile 9 in. long, bedded and pointed.*

		s.	d.
$1\frac{1}{3}$ ridge tiles	@ 7*s.* doz.		$9\frac{1}{2}$
Materials for bedding and pointing			$1\frac{1}{2}$
Labour, bedding and pointing			4
	Per foot run, net	1	3

PLUMBER

The price of lead pipe and sheet is based upon the current price of pig lead, which is governed by the rates obtaining on the metal exchange. The price of lead is apt to fluctuate very considerably.

Sheet Lead

The current price of sheet lead is £31 10*s.* per ton, for full sheets or half-sheets, delivered London area. There is an extra charge of £1 per ton for delivery to specified counties outside the London area.

Quantities of less than one half-sheet are charged extra, according to the total weight ordered, plus an added charge for cutting to size.

Extra charges for small quantities.

Quantity under 5 cwt. and not less than 3 cwt.	2*s.* 6*d.* per cwt.
Quantity under 3 cwt. and not less than 1 cwt.	4*s.* 0*d.* ,, ,,
Quantity under 1 cwt.	5*s.* 0*d.* ,, ,,

Extra charges for cutting sheet lead to size.

Cutting to rectangular shapes under 15 ft. long or 7 ft. wide	3*s.* 0*d.* ,, ,,
Ditto, under 5 cwt.	4*s.* 0*d.* ,, ,,
Cutting circles and shapes other than rectangular	4*s.* 0*d.* ,, ,,
Ditto, under 5 cwt.	5*s.* 0*d.* ,, ,,

Waste on Sheet Lead

The cut-offs from lead may be resold to the lead mills, the value of the scrap being about 13*s.* per cwt. less than the current basis price of sheet lead. An allowance of 4 lb. per cwt. is deducted from the total weight for "dross."

For sheet-lead work the measurement waste will be about 5 per cent. In practice most of the cut-offs are used for small lengths of flashings, lead wedges, and lead for caulking pipe joints.

Labour Values for Sheet-lead Work

Labour, laying sheet lead, including hoisting not exceeding 40 ft. in height. Equal times of plumber and mate.

Milled sheet lead and laying, per cwt.	
Flats	3 hours
Gutters and flashings	$3\frac{1}{2}$,,
Stepped flashings	$4\frac{1}{2}$,,
Soakers, cut and bent only	2 ,,
Lead damp-proof course	2 ,,
Gutters and damp-proof courses to hollow walls	$2\frac{1}{2}$,,
Lineal labours, per foot run.	
Welted ridge	$\frac{1}{10}$,,
Welted lap	$\frac{1}{6}$,,
Bedding edge in white lead	$\frac{1}{10}$,,
Burning into groove in stonework	$\frac{1}{5}$,,
Lead wedging to horizontal flashings	$\frac{1}{20}$,,
Ditto, to stepped flashings	$\frac{1}{10}$,,
Open copper nailing	$\frac{1}{20}$,,
Close copper nailing	$\frac{1}{8}$,,
Soldered angle	$\frac{1}{3}$,,
Dressing lead over irregular surfaces, extra labour	$\frac{1}{6}$,,
Dressing lead into hollow of secret gutters, extra labour	$\frac{1}{8}$,,
Dressing lead over mouldings, extra labour per foot girth of moulding, from	$\frac{1}{6}$,,
Numbered labours, each.	
Bossed ends to rolls	$\frac{1}{4}$,,
Bossed intersection of lead-clothed ridge and two hips	$\frac{1}{2}$,,
Bossed angle 6 in. high	$\frac{1}{3}$,,
Extra labour to cesspits	2 ,,
Soldered dots	$\frac{1}{2}$,,
Lead plugs	$\frac{1}{5}$,,

Examples of Detailed Price Analysis

(79) *Milled sheet lead in flats.*

		£	s.	d.
1 cwt. sheet lead	@ 31*s.* 6*d.* per cwt.	1	11	6
Waste, 5 per cent. of 13*s.* 9*d.* (see below)				$8\frac{1}{4}$
Plumber, 3 hours	@ 1*s.* 8*d.*		5	0
Mate, 3 hours	@ 1*s.* 3*d.*		3	9
	Per cwt., net, say	£2	0	11

Waste value on sheet lead.

	£	s.	d.
1 cwt. new sheet lead	1	11	6
Deduct 1 cwt. lead scrap, less 4 lb. for dross—108 lb. at 18*s.* 6*d.* per cwt.		17	9
Basis for waste value per cwt.		13	9

(80) *Milled sheet lead in stepped flashings.*

		£	s.	d.
1 cwt. sheet lead	@ 31*s.* 6*d.*	1	11	6
Waste, 5 per cent.	@ 13*s.* 9*d.*			$8\frac{1}{4}$
Plumber, $4\frac{1}{2}$ hours	@ 1*s.* 8*d.*		7	6
Mate, $4\frac{1}{2}$ hours	@ 1*s.* 3*d.*		5	$7\frac{1}{2}$
	Per cwt., net, say	£2	5	4

			s.	d.
(81)	*Lead wedging to stepped flashings.*			
	Plumber, $\frac{1}{10}$ hour	@ 1s. 8d.		2
	Mate, $\frac{1}{10}$ hour	@ 1s. 3d.		1½
	Lead for wedges, say			1½
		Per foot run, net		5

(*Note.*—For wedging to flashings in short lengths add 100 per cent. to the labour values given.)

			s.	d.
(82)	*Soldered dot.*			
	1 lb. solder..	@ 1s. 3d.	1	3
	Copper screw, washer, and sundries			3
	Plumber, ½ hour	@ 1s. 8d.		10
	Mate, ½ hour	@ 1s. 3d.		7½
		Each, net	2	11½

Lead Pipe

The current price for lead pipe, water-pipe basis, is £31 per ton, delivered London area. For quantities less than full coils or lengths a charge of 2*s.* per cwt. is made for cutting, plus a further 1*s.* per cwt. if the total quantity is under 5 cwt.

Lead soil pipe is 5*s.* 3*d.* per cwt. above the basis for water pipe.

Waste on Lead Pipes

Waste on lead pipes will vary to some extent with the length in which the pipe is supplied.

Lead pipe is manufactured in the following size coils and lengths :—

½-in. to 1-in. diameter	60-foot coils
1¼-in. to 2-in. ,,	36 ,, ,,
2½-in. to 6-in. ,,	10 ,, lengths

Pipes of 1½-in. to 2-in. diameter are also supplied in 12-ft. lengths.

Allowances for waste, based on the difference in value between the price of lead pipe and scrap lead :—

Pipes supplied in coils	2½ per cent.
Pipes supplied in lengths	5 ,, ,,
Pipes 1½ in. diameter and over when fixed in short lengths	10 ,, ,,

Weights of Lead Pipes

The weights of lead pipes for water-supply, waste, and soil pipes required by the various authorities are given in another part of this work.

It should be noted that in the area served by the Metropolitan Water Board, distributing pipes are permitted of a less weight than is required for service pipes. Broadly speaking, service pipes may be defined as supply pipes conveying water under mains pressure, and distribution pipes as all pipes supplied from a storage tank.

Ternary Alloy Lead Pipe

In the Metropolitan Water Board area the use of Ternary Alloy lead pipe is permitted in certain cases. The permitted weight of the Ternary Alloy pipe is approximately one-third less than is provided for lead pipes of similar diameter.

The price of Ternary Alloy lead pipe is about £7 per ton above the basis price for lead water pipe and is subject to the same extra charges for small quantities, etc.

Ternary Alloy lead pipe does not appear to be in general use, and it will probably be found that the pipe, if required, will be specially drawn to order.

Labour Values fixing Lead Pipes

Normal values for fixing lead pipes in carcass work. The labours include for pipe clip or hook fixing for pipes up to 1½ in. diameter ; lead tack fixing for 2-in. diameter pipes and above. Equal times of plumber and mate.

Lead services and wastes, per foot run.

½ in. diameter (including bends)	$\frac{1}{7}$ hour
¾ in. ,, ,, ,,	$\frac{1}{5}$,,
1 in. ,, ,, ,,	¼ ,,
1¼ in. ,, ,, ,,	$\frac{3}{10}$,,
1½ in. ,, (bends extra)	$\frac{3}{10}$,,
2 in. ,, ,, ,,	⅓ ,,
2½ in. ,, ,, ,,	$\frac{2}{5}$,,
3 in. ,, ,, ,,	½ ,,

Soil pipes.

3½ in. diameter (bends extra)	½ hour
4 in. ,, ,, ,,	$\frac{3}{5}$,,

For pipes laid in trenches or conduits *deduct* 50 per cent. from the values given for pipes supplied in coils and 25 per cent. for pipes supplied in lengths.

The labour fixing lead pipes in short lengths is about one-third more than for normal fixing.

Wiped Solder Joints

The table gives the labour values and the amount of solder required for wiped running joints. The value of one running joint must be added to the cost of fixing a complete length or coil of pipe, the only joints separately measured being branch, fittings, and reducing joints.

RUNNING JOINTS—EACH

Diameter of Pipe	*Plumber and Mate*	*Solder*	*Sundries*
½ in.	½ hour	½ lb.	½*d.*
¾ in.	$\frac{3}{5}$,,	¾ ,,	½*d.*
1 in.	$\frac{7}{10}$,,	1 ,,	½*d.*
1¼ in.	¾ ,,	1¼ ,,	1*d.*
1½ in.	$\frac{4}{5}$,,	1½ ,,	1*d.*
2 in.	$\frac{9}{10}$,,	2 ,,	1½*d.*
2½ in.	1 ,,	2½ ,,	1½*d.*
3 in.	1⅛ ,,	3¼ ,,	2*d.*
3½ in.	1¼ ,,	4 ,,	2*d.*
4 in.	1½ ,,	4¾ ,,	2½*d.*

For branch joints and joints to fittings add 12½ per cent. to the complete value of the running joint.

Branch joints for pipes of unequal diameters and reducing joints should be priced at the value of a joint for the pipe of larger diameter.

Detailed Price Analysis

(83) *¾-in. diameter wiped running joint.*

		s.	d.
¾ lb. plumber's solder	@ 1s. 3d.		11¼
Sundries			½
Plumber and mate, ⅗ hour	@ 2s. 11d.	1	9
	Each, net, say	2	9

(84) *¾-in. diameter lead service pipe, weighing* 11 *lb. per yard and fixing in carcass work.*

		s.	d.
1 ft. 3⅔ lb. ¾-in. lead pipe	@ 31s. 0d. per cwt.	1	0
Waste, 2½ per cent. (on 3⅔ lb.)	@ 13s. 3d. per cwt.		—
1/60 of cost of one ¾-in. running joint	@ 2s. 9d.		½
Pipe clips, etc.			¼
Plumber and mate, ⅕ hour	@ 2s. 11d.		7
	Per foot run, net	1	7¾

(85) *¾-in. diameter lead service pipe, weighing* 11 *lb. per yard and laying in trench.* (Trench measured separately.)

		s.	d.
1 ft. 3⅔ lb. ¾-in. lead pipe	@ 31s. per cwt.	1	0
Waste			—
Proportion of cost of running joint			½
Plumber and mate, 1/10 hour	@ 2s. 11d.		3½
	Per foot run, net	1	4

(86) *¾-in. diameter Ternary Alloy lead service pipe, weighing* 7½ *lb. per yard and fixing in carcass work.*

		s.	d.
1 ft. 2½ lb. Ternary Alloy lead pipe	@ 38s. per cwt.		10¼
Waste			—
Proportion of cost of running joint and pipe clips			¾
Plumber and mate, ⅕ hour	@ 2s. 11d.		7
	Per foot run, net	1	6

(87) *¾-in. diameter lead distribution pipe, weighing* 8 *lb. per yard and fixing in carcass work.*

		s.	d.
1 ft. 2⅔ lb. ¾-in. lead pipe	@ 31s. cwt.		8¾
Waste, running joint, and pipe clips as before			¾
Plumber and mate, ⅕ hour	@ 2s. 11d.		7
	Per foot run, net	1	4½

Bends in Lead Pipe

Labour, forming bends in lead pipes.

Each	*Plumber and Mate*
1½ in. diameter pipe	¾ hour
2 in. " "	1 "
2½ in. " "	1¼ "
3 in. " "	1⅝ "
3½ in. " "	2 "
4 in. " "	2½ "

Wiped Stopped Ends

Based on the value of a wiped running joint of equal diameter.

$\frac{1}{2}$-in. and $\frac{3}{4}$-in. diameter pipes	$\frac{1}{3}$ value of running joint
1-in. to $1\frac{1}{2}$-in. ,, ,, ...	$\frac{1}{2}$,, ,, ,, ,,
2-in. diameter pipe and over	$\frac{3}{4}$,, ,, ,, ,,

Plumber's Brasswork

In addition to the value of the fitting and the wiped joint, a small allowance for fixing the fitting should be made in the case of taps, ball valves, etc., needing adjustment after fixing.

Iron Gas, Water, and Steam Pipes

Labour fixing and jointing tubes and fittings in carcass work, normal runs of pipe. Times of plumber and mate in hours.

	Diameter of Tube					
	$\frac{1}{2}$ *in.*	$\frac{3}{4}$ *in.*	1 *in.*	$1\frac{1}{4}$ *in.*	$1\frac{1}{2}$ *in.*	2 *in.*
Tubes, including all running fittings. Per foot run	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{7}$	$\frac{1}{5}$	$\frac{1}{4}$	—
Tubes, including connectors only.. ..	—	—	—	—	—	$\frac{1}{4}$
Tees, each	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1
Cocks, etc., each ..	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{2}$
Bends, each	—	—	—	—	—	$\frac{1}{2}$

Add 50 per cent. to the labour values given, for very short runs of pipe, as in small domestic buildings. For long runs of pipe in trenches or conduits, *deduct* 50 per cent.

Tubes and Fittings

The price of tubes and fittings of all qualities is based on a Standard Price List. This price list gives a fixed gross price for pipes and fittings for each diameter, the net price being regulated by a series of discounts.

In pricing iron services all short lengths, connectors, and fittings (other than cocks, lees, reducing fittings, and plugs) are included with the price of pipe per foot run for all pipes under 2 in. diameter. To cover the cost of these running fittings the following additions should be made to the net cost of the pipe :

Long runs of pipe in trenches or conduits	10 per cent.
Normal carcass work	33 ,, ,,
Very short runs of pipe..	50 ,, ,,

Detailed Price Analysis

(88) *1-in. diameter galvanised steam tube and laying in long lengths in conduits.*

	s.	d.
12 ft. 1 in. diameter iron tube (Standard List price) .. @ $9\frac{1}{4}$ ft.	9	3
Deduct current discount for wrought mild steel galvanised steam tube, $42\frac{1}{2}$ per cent.	3	11
	5	4
Waste, 5 per cent.		3
	5	7
Add allowance for connectors, bends, short lengths of pipe, etc., 10 per cent.		$6\frac{3}{4}$
	12)6	$1\frac{3}{4}$
Per foot run, say		$6\frac{1}{4}$
Jointing materials		$\frac{1}{4}$
Plumber and mate, $\frac{1}{14}$ hour .. .. @ 2*s.* 11*d.*		$2\frac{1}{2}$
Per foot run, net		9

(89) *1-in. diameter galvanised steam tube and fixing in normal carcass work.*

	s.	d.
12 ft. 1 in. diameter iron tube (Standard List price) .. @ $9\frac{1}{4}$ ft.	9	3
Deduct discount for galvanised steam tube as before, $42\frac{1}{2}$ per cent.	3	11
	5	4
Waste, 10 per cent.		$6\frac{1}{2}$
	5	$10\frac{1}{2}$
Add allowance for running fittings, 33 per cent.	1	$11\frac{1}{2}$
	12)7	10
Per foot run, say		$7\frac{3}{4}$
Jointing materials and pipe hooks		$\frac{1}{2}$
Plumber and mate, $\frac{1}{7}$ hour .. .. @ 2*s.* 11*d.*		5
Per foot run, net	1	$1\frac{1}{4}$

(90) *1-in. diameter galvanised steam tee.*

	s.	d.
1 1-in. iron tee (Standard List price)	1	10
Deduct current discount for galvanised steam *fittings*, $37\frac{1}{2}$ per cent.		$7\frac{3}{4}$
Net	1	$2\frac{1}{4}$
Materials for joint		$1\frac{1}{2}$
Labour, fixing tee, including labour cutting and threading pipe, plumber and mate, $\frac{1}{2}$ hour .. .. @ 2*s.* 11*d.*	1	$5\frac{1}{2}$
Each, net	2	$9\frac{1}{4}$

PAINTER

Paint—Spreading Power

The spreading power of the majority of proprietary brands of paint varies from 70 to 90 square yards per gallon. The nature of the surface to be covered and the temperature will affect the spreading power. Under average conditions 1 gallon of paint will cover 80 square yards, one coat.

Materials for Preparatory Work

The value of materials for knotting and stopping on new woodwork, assuming that good-quality joinery timber is used, is about $\frac{1}{4}$*d.* per yard super.

Labour

The labour applying paint will be greater for framed joinery than for flat surfaces.

Additional labour is entailed when painting is carried out from ladders, but in new buildings external painting is usually done from a scaffold, the cost of which is separately charged in the preliminary bill.

The following labours are for painting on new work :—

Painting on joinery—per yard super.	
Knot, prime, stop, and paint two coats	$\frac{3}{5}$ hour
Knot, prime, stop, and paint three coats	$\frac{3}{4}$,,
Knot, prime, stop, and paint four coats	$\frac{9}{10}$,,
Painting on flat surfaces—per yard super.	
For each coat of paint	$\frac{1}{7}$,,

Paintwork cut in on Both Edges

Extra labour is necessary for running items not exceeding 12 in. in width or girth and cut in on both edges. This extra labour is worth approximately 1*d.* per yard run for each coat of paint actually cut in. In practice priming and the second coat of paint are applied before the joinery is fixed, and the value of these two preparatory coats may be taken at basic values.

Painting on Wood Sashes and Frames

Painting on frames, mullions, and transoms is measured by the yard run, each side being separately measured, and should be priced as a running item 9 in. wide cut in on both edges, i.e. the whole girth of the frame being equal to a girth of $1\frac{1}{2}$ superficial feet plus the labour cutting in to the finishing coats.

Painting to sash squares is treated as a numerical item, and the sash squares are grouped in various sizes. One dozen squares (each side) may be taken as being equal to a given number of yards super of painting as follows :—

Squares not exceeding 2 ft. 6 in. superficial (termed squares)	As 2 yd. super of painting per dozen squares
Squares exceeding 2 ft. 6 in. but not exceeding 5 ft. superficial (large squares)	As 3 ,, ,, ,, ,, ,, ,, ,,
Squares exceeding 5 ft. but not exceeding 10 ft. superficial (extra large squares)	As 4 ,, ,, ,, ,, ,, ,, ,,

For squares above 10 ft. superficial in area, the girth around the square should be measured and priced as equal to a running item, cut in on both edges, 3 in. wide.

Painting on Iron and Steel

The spreading power of paint on iron and steel may be taken as given previously for painting on woodwork. Iron oxide paint covers about 100 square yards per gallon and aluminium paint about 120 square yards per gallon.

Labour value painting to ironwork over 12 in. wide, $\frac{1}{8}$ hour per yard super.

Painting to steel frames (each side) should be taken as equal to a running item 4 in. wide cut in on both edges ; painting to squares at two-thirds of the values given for wood squares.

Varnishing and Enamelling

Average spreading power of varnishes and enamels, 80 yd. super per gallon.

Labour values on joinery.

Varnishing	$\frac{1}{6}$ hour per yard super
Enamelling	$\frac{1}{4}$,, ,, ,, ,,

Examples of Detailed Price Analysis

(Spreading power of paint taken at 80 yd. super per gallon.)

(91) *Knot, prime, stop, and paint three coats.*

		s.	d.
Materials for knotting, stopping, etc.			$\frac{1}{4}$
Material for four coats of paint, $\frac{4}{80} = \frac{1}{20}$ gal. paint ..	@ 15*s.* 0*d.*		9
Painter, $\frac{3}{4}$ hour	@ 1*s.* 7*d.*	1	$2\frac{1}{4}$
Per yard super, net		1	$11\frac{1}{2}$

(92) *Knot, prime, stop, and paint three coats on skirting 9-in. girth.*

		s.	d.
3.0 .9 2.3—$\frac{1}{4}$ yd. super	@ 1*s.* $11\frac{1}{2}$*d.*		6
Extra labour cutting in on two edges to the last two coats of paint— 2 yd.	@ 1*d.* per yd.		2
Per yard run, net			8

Note.—This example is typical for all running items, and the price given will apply to wood sash frames, one side.

(93) *Knot, prime, stop, and paint three coats on sash squares not exceeding 2 ft. 6 in. super.*

		s.	d.
1 doz. sash squares as equal in value to 2 yd. super of plain painting, 2 yd. super	@ 1*s.* $11\frac{1}{2}$*d.* per yd.		
Per doz., net		3	11

(94) *Knot, prime, stop. and paint three coats to sash squares size 4 ft. by 3 ft.* (each side). Girth of sash square, 14-ft. run.

Basis price per yard run.

		s.	d.
3.0 ·3 .9—$\frac{1}{12}$ yd. super	@ 1*s.* $11\frac{1}{2}$*d.*		2
Extra labour cutting in two coats to edges			2
Per yard run, net			4

Price per square (*one side*).

		s.	d.
Girth, 14 ft.—$4\frac{2}{3}$ yd. run at 4*d.*	Each square, net	1	$6\frac{1}{2}$

PAPERHANGER

Materials

The size of a roll of English-made wallpaper is $11\frac{1}{2}$ yd. long and 21 in. wide.

An allowance of one piece of wallpaper in seven is made by the quantity surveyor in the Bill of Quantities, and this is sufficient to provide for waste in trimming, matching, and length-cutting.

The cost of paste for hanging wallpaper is about 3*d.* per piece.

Labour, Trimming and Hanging Papers—per piece

The following labour values are for hanging ordinary-quality papers not requiring straight-edge trimming.

Lining papers.	
On walls	$\frac{1}{2}$ hour
On ceilings	$\frac{3}{4}$,,
Wallpapers.	
On ordinary walls	$\frac{3}{4}$,,
On dadoes	$\frac{7}{8}$,,
On staircases	1 ,,
Ceiling papers.	
Mica or similar type papers	1 ,,
Borders and friezes (per dozen yards).	
Not exceeding 6 in. wide	$\frac{3}{4}$,,
Exceeding 6 in. and not exceeding $10\frac{1}{2}$ in. wide	1 ,,
Exceeding $10\frac{1}{2}$ in. wide	$1\frac{1}{4}$,,
Styling borders, including setting out	$1\frac{1}{2}$,,

The value of fixing motifs and corner ornaments will vary with size and design, about 20 per cent. of the net cost of the article being a reasonable price.

Low-relief papers.	
On walls	$1\frac{3}{4}$ hours per piece
On dadoes	2 ,, ,, ,,
On ceilings	$2\frac{3}{4}$,, ,, ,,

POLISHER

The following are typical net trade prices for polishing :—

Bodying in and French polishing on hardwood joinery	9*d.* per foot super
Ditto, to sash bars not exceeding 4-in. girth	$4\frac{1}{2}$*d.* ,, ,, run
Ditto, to mouldings, per inch of girth	1*d.* ,, ,, ,,
Staining and wax polishing on hardwood joinery	$4\frac{1}{2}$*d.* ,, ,, super
Ditto, to sash bars not exceeding 4-in. girth	3*d.* ,, ,, run
Ditto, to mouldings, per inch of girth	$\frac{1}{2}$*d.* ,, ,, ,,
Staining and wax polishing floors	1*s.* 6*d.* per yard super

GLAZIER

Sheet Glass

English sheet glass is supplied in "ordinary glazing" and "selected glazing" qualities, in thicknesses weighing 18, 24, 26, and 32 oz. per foot super.

Ordinary glazing quality is normally used for building work. English sheet glass in full crates :—

Ordinary glazing quality.

18 oz.	$2\frac{1}{4}d.$ per foot super
24 oz.	$3\frac{3}{8}d.$,, ,, ,,
26 oz.	$3\frac{5}{8}d.$,, ,, ,,
32 oz.	$6d.$,, ,, ,,

Selected glazing quality.

18 oz.	$2\frac{1}{2}d.$ per foot super
24 oz.	$3\frac{5}{8}d.$,, ,, ,,
26 oz.	$4\frac{1}{4}d.$,, ,, ,,
32 oz.	$6\frac{3}{4}d.$,, ,, ,,

Waste value on sheet glass will vary with the size sheet to be cut from stock sizes ; 10 per cent. should be sufficient for the sizes generally used in building work.

There are very many other types of glass, such as figured, rolled, rough cast plate, cathedral, wired cast, etc., prices for which can be obtained from trade lists.

Labour glazing sheet glass in average-size squares, one-sixth hour per foot super. The value of putty and spriggs for glazing is rather less than $\frac{1}{2}d.$ per foot super of glass, on the basis of $\frac{1}{4}$ lb. of putty per foot super of glass.

Plate Glass

Plate glass is purchased cut to size. Polished plate of ordinary thickness is *about* $\frac{1}{4}$ in. thick ; other thicknesses are charged at increased prices.

The tariff for polished plate glass contains prices for glass of ordinary thickness with specified extra prices for special thicknesses. It should be noted that the price of plate glass varies considerably with the superficial area of the plate.

The trade price for glazing polished plate glass is 6*d.* per foot super. When 200 feet super or over are glazed at one time this price is reduced to 4*d.* per foot super.

Bedding edges of glass in wash-leather, for door panels, etc., 3*d.* per foot run of glass edge.

AERODROMES AND AIRPORTS

PART II.—AERODROME BUILDINGS

AERODROME buildings may be divided into the following general classes :—

Administration, staff accommodation, hangars, workshops, and factories.

The illustrations accompanying this article show a few typical arrangements, but naturally the conditions of the site of any particular aerodrome will have an influence upon the design ultimately adopted. There is no doubt that there is a wide divergence between the classes, dimensions, and character of aerodrome buildings, and for this reason it is not possible to generalise upon the subject and lay down more than general indications of the requirements.

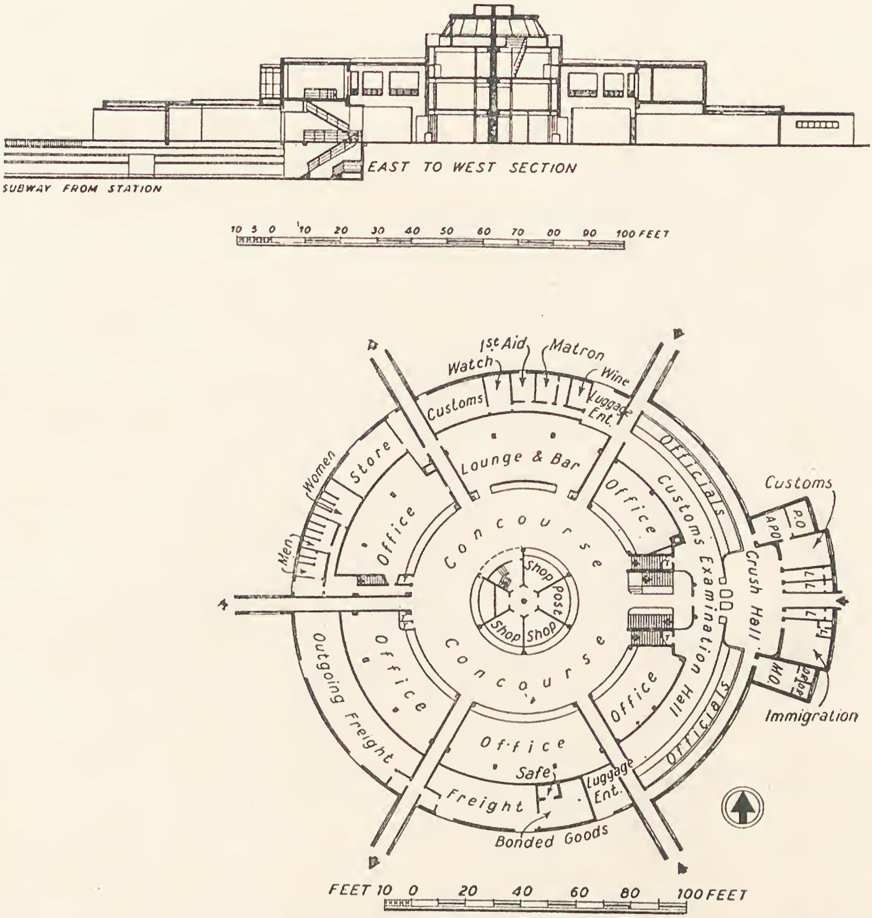
Administration Buildings

The accommodation to be provided in the building of any airport must provide for the following :—

Administration.
Aerodrome control.
Wireless.
Meteorological office.
Administrative offices.
Government services, including customs and immigration officials.
C.I.D.
Bonded stores, etc.
Operating companies.
Administrative and managerial offices.
Booking-offices.
Parcels offices.
Public waiting-rooms.
Bookstalls.
Buffet or restaurant for passengers, and other arrangements for people who visit the aerodrome.

Control Room

The control room must have a look-out gallery all round it, and must command a full view in all directions through large windows. It is, therefore, usual to construct this in a tower in some central position on the administrative buildings.



[*By courtesy of "The Architects' Journal."*

Fig. 1.—GATWICK AIRPORT

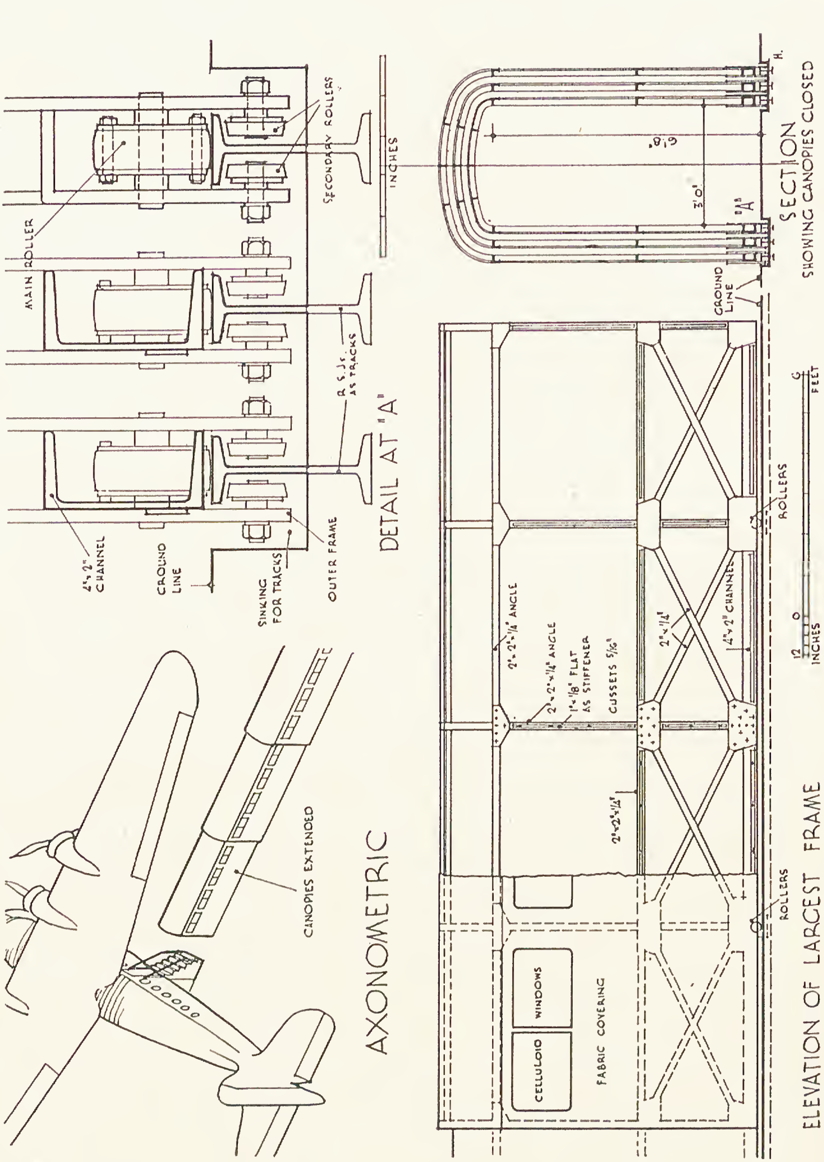
A section through the main concourse and the ground-floor plan. The control tower windows are sloped inward to prevent reflections from boundary lights.

A typical arrangement of administrative building is shown in Fig. 1, which gives the ground-floor plan of Gatwick, and a section which indicates the subway from the station giving access to it.

It is interesting to note that the glazing of the windows of the control tower is inclined at such an angle that the boundary lights of the aerodrome do not cause troublesome reflections in it.

Canopies

Problems connected with the docking of the aeroplane and the transfer of passengers from the machine to the station are dealt with



[*By courtesy of "The Architects' Journal"*

Fig. 2.—DETAILS OF EXTENDING CANOPIES AT THE NEW GATWICK AIRPORT
(*Architects: Hoare, Marlow and Lovett.*)

at different airports in a number of different ways. At Speke, provision is made for taxying the aeroplane underneath a permanent canopy, but there is no means of protecting the passenger from the slipstream of the aeroplane propellers.

At Gatwick, the extended portable canopies illustrated in Fig. 2 are used for this purpose. With large aeroplanes, the wings pass over the top of the extended canopy, and the latter affords protection to the passenger entering or leaving the aeroplane in all weathers, and also screens him from the slipstream from the propellers.

At Croydon the machines are manœuvred with motor tractors, and are brought to a suitable position for the loading of mails and the embarkation of passengers.

A careful study of the plans and details referred to above is well justified, and the extent of the accommodation provided must of course be adjusted to suit the requirements of the case.

Garages

On all aerodromes there should be ample space for the establishment of private-car parks and parking-places for motor-coaches, but covered garage accommodation is also very desirable.

Petrol and oil and service stations should also be established as a subsidiary to the public garages attaching to aerodromes, and the type of building suitable for this purpose does not differ from that usually employed elsewhere.

Hangars

Hangars are of course essential to any aerodrome, their number and size depending upon the amount of traffic to be expected, and the size and quantity of machines housed. The essentials of the modern hangar are as below :—

(*a*) They must be large enough to house the largest machine expected to use the airport, and provide ample space for the convenient manœuvring of these machines in and out of the building.

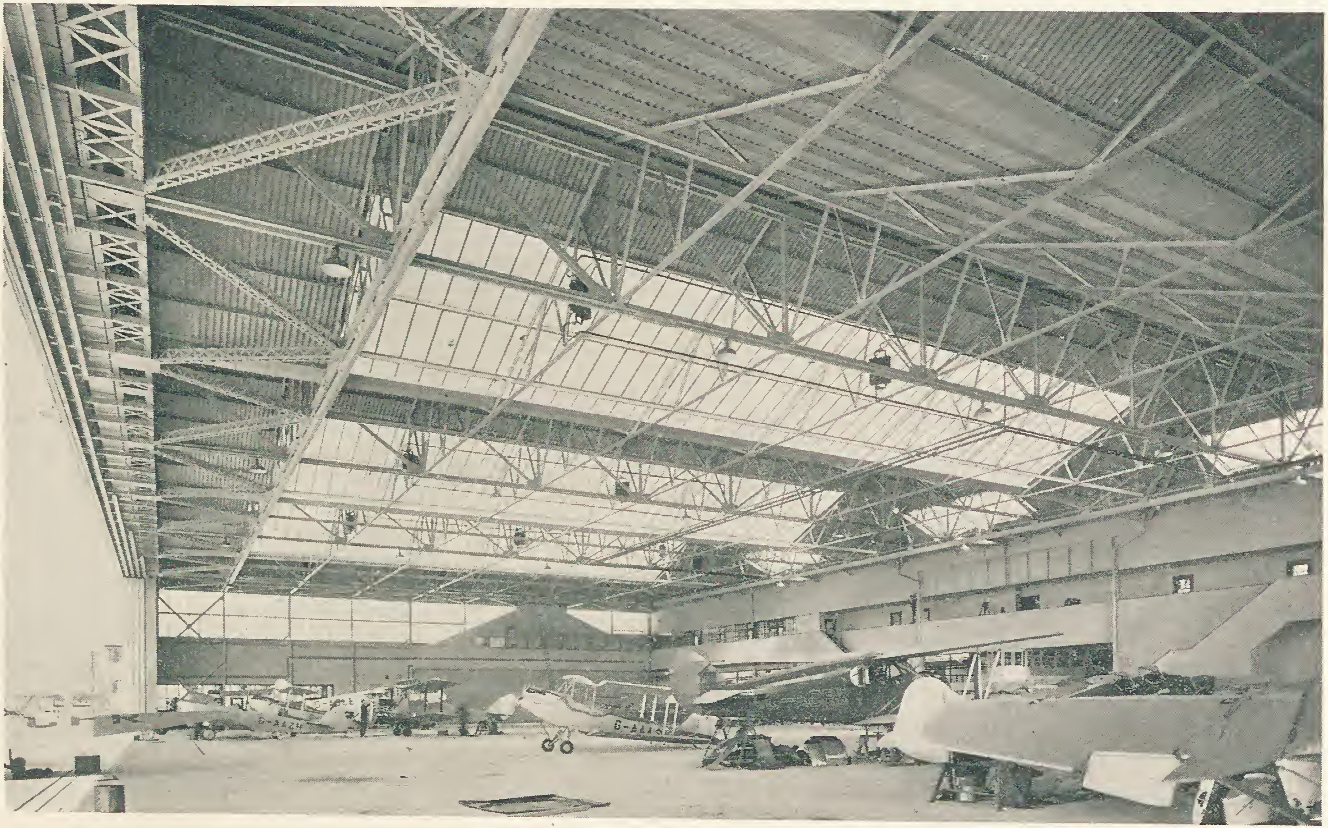
(*b*) The doors must extend across the full width of the front of the hangar, and must be easily operated.

(*c*) Each machine housed should have direct access to the apron in front of the building, without the necessity of manœuvring other machines out of the way.

(*d*) The roof should be lofty and well lit, providing height for the accommodation of the tallest machine, with ample working space above provided with lifting-gear capable of handling parts up to 2 tons in weight.

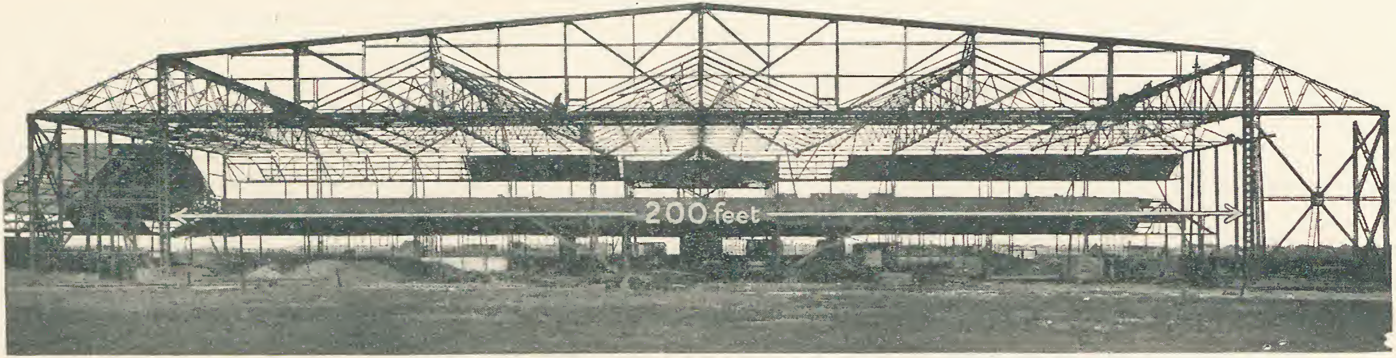
(*e*) The heating, lighting, and ventilation of the building should receive the same attention as that necessary in a workshop in order to provide suitable conditions in all weathers throughout the year.

(*f*) In order to minimise the cost of heating and ventilation, the height



[By courtesy of the British Constructional Steelwork Association

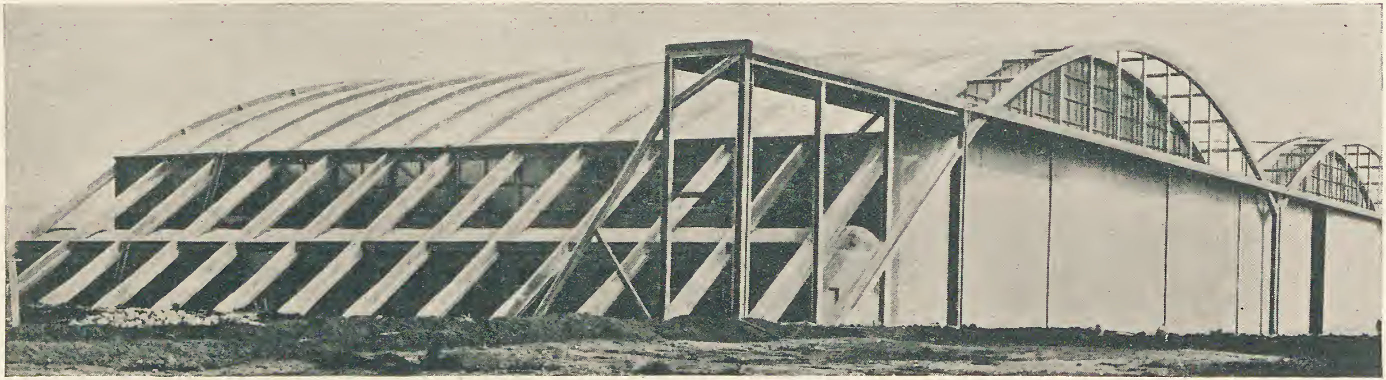
Fig. 3.—INTERIOR OF THE WORKSHOP HANGAR AT HESTON AIRPORT, LONDON
The clear span of this hangar is 250 ft. and the door opening 200 ft. clear. (*Architect : Graham R. Dawbarn*)



[By courtesy of the British Constructional Steelwork Association

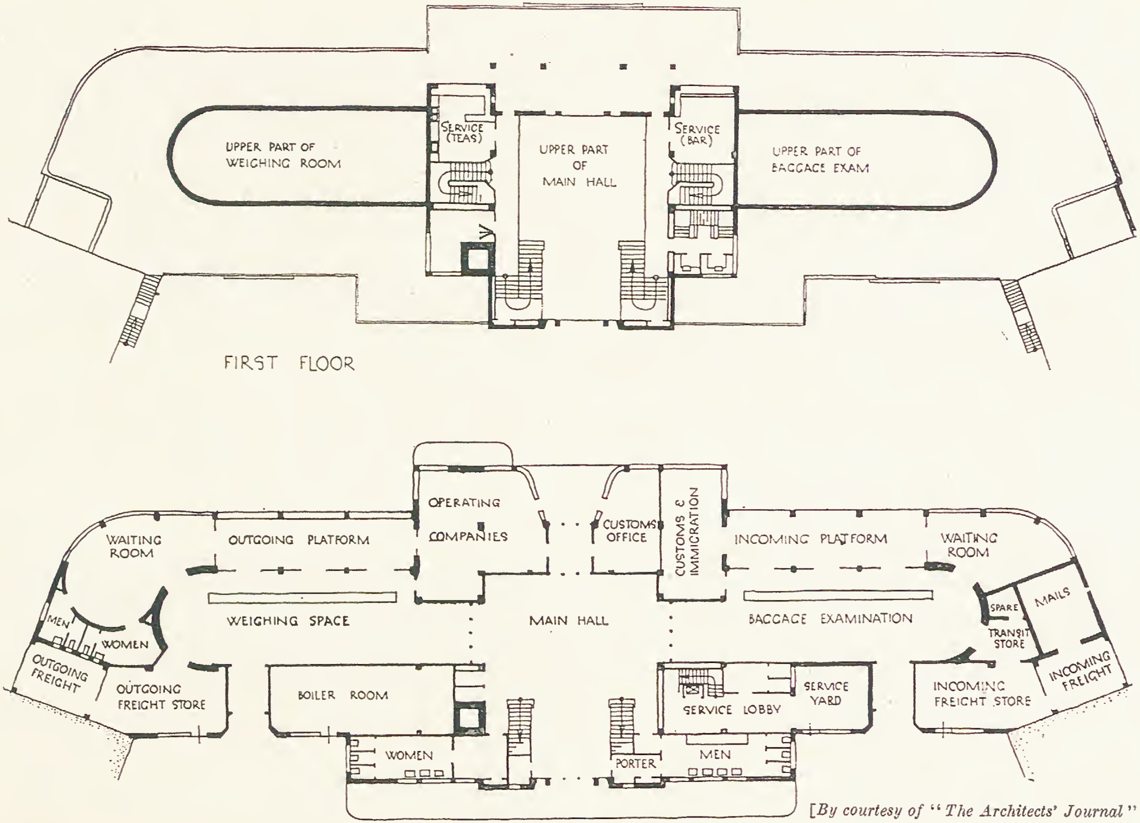
Fig. 4.—Heston workshop hangar

Front view of the 200-ft.-span fascia girder and cantilever truss construction.



[By courtesy of the Cement & Concrete Association

Fig. 5.—Reinforced-concrete hangars at Tunisia



[By courtesy of "The Architects' Journal"

Fig. 6.—JERSEY AIRPORT, TERMINAL BUILDING—GROUND FLOOR AND FIRST FLOOR

Second floor, restaurant, kitchen, etc. Third floor, administrative and meteorological offices. Top floor, control and wireless rooms. (*Architect: Graham R. Dawbarn.*)

should of course be kept to a minimum, consistent with the requirements set out above.

Workshop Hangar at Heston Airport

The new workshop hangar at Heston Airport is an excellent example of the construction of hangars for heavier-than-air machines.

The building is a striking testimony to the foresight of Airworks Limited, who have anticipated the future expansion of aircraft, and made an ample provision in the layout of the hangar to cope with the estimated future requirements.

The hangar itself has an area of 32,450 sq. ft., completely free from any columns or supports. The main doorway at the front of the hangar has an unobstructed width of 200 ft., with a clear height of 30 ft., as shown in Fig. 4. The opening is closed by eight steel-framed doors, each 26 ft. wide, mounted on roller-bearing wheels. At present the doors are operated by man power through gearing, though provision has been made for the installation of an electric drive at a later date.

The steelwork supporting the roof of the hangar consists of the fascia girder, 200-ft. span, five main-roof girders, 126-ft. span, and thirty-five double-cantilever roof principals, the whole being carried by ten stanchions at the edges of the hangar floor.

There are three framed, horizontally disposed wind girders, one of 250-ft. span, and the others each of 126-ft. span. Allowances have been made for expansion and contraction due to changes of temperature.

The workshops required in connection with the functioning of this particular hangar are grouped at the back and on each side of the main building. These consist of the engine workshop, the woodwork shop, the paint shop, and stores, these latter being placed centrally for convenient service to the workshops on either side.

The main offices required in the administration of the work carried on in this building are situated above the stores, engine, and woodworking shops, the office floor area being 5,600 sq. ft. Lavatories, first-aid room, garage for motor ambulance, and offices for the supervising operatives are also provided. The roofs are covered with corrugated asbestos sheets on steel purlins, with panels of patent glazing.

Hangars can also be built from standardised steel units, giving an arch-shaped structure (lamella construction). In these arched structures there is, however, a lack of head-room near the springings of the arch, and this largely restricts the working floor space when tall machines are to be accommodated. For stores, however, such buildings are particularly useful.

Concrete for Aerodrome Buildings

An arched form of construction is adopted in the French Air Force reinforced-concrete hangars at Tunisia. Regarding the use of concrete for aerodrome buildings, the following facts are of interest.

Steel construction, with the usual type of covering, is usually cheaper in first cost, but concrete usually works out cheaper after about six years of service, since the subsequent maintenance cost is negligible. The true index of value is, of course, the cost over a period of years, and if this is taken into consideration the more permanent concrete construction is usually the better financial proposition.

The reduction in the fire hazard in the adoption of concrete buildings is also of considerable importance, particularly as fuels used by aeroplanes are so highly inflammable.

The over-all dimensions of a number of well-known types of plane are given in the Table which follows.

SIZES OF AEROPLANES

Type and Number of Passengers, excluding Crew	*Span*		*Length*		*Height*	
BIPLANES—	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Handley Page 42 (38 passengers)	130	0	89	9	27	0
Short "Scylla" (39 passengers)	113	0	86	3	29	6
De Havilland 86 (16 passengers)	64	6	46	1¼	13	0
MONOPLANES—						
Fokker F.XX (12 passengers)	90	0	54	9	15	7
Fokker F.XXII (22 passengers)	108	0	78	8	19	8
Douglas D.C.2 (14 passengers)	85	0	61	11¾	16	3¾
Fokker F.XXXVI (32 passengers)	98	4	72	2	16	1
Avro 642 (16 passengers)	71	3	54	6	11	6
Junkers Ju 52/3m (17 passengers)	96	9	62	0	14	10
Junkers G.38 (34 passengers)	144	4	75	6	22	6
Wibault Penhoet (10 passengers)	74	1	55	9	18	9
Savoia Marchetti S–73 P. (18 passengers)	78	8½	57	2½	15	0

This Table will serve as a general guide to the clearances which must be provided in hangars, although, of course, the trend of aircraft design will naturally be reflected in the design of the accommodating hangar.